A BASIC GUIDE
TO THE
KENNEBUNK RIVER AND ITS TRIBUTARIES
FOR
ARUNDEL, KENNEBUNK, AND KENNEBUNKPORT

INCLUDING: RIVER RESOURCE DATA

NATURAL RESOURCE INFORMATION

NEW METHODS TO QUANTIFY:

*** GROUNDWATER CONTAMINATION VULNERABILITY**

*** WILDLIFE DIVERSITY**

*** WETLANDS VALUES**

SUGGESTED THREE-TOWN COORDINATED ORDINANCES

M. Coastal Zone Management Program

A BASIC GUIDE

TO THE

KENNEBUNK RIVER AND ITS TRIBUTARIES

FOR

ARUNDEL, KENNEBUNK, AND KENNEBUNKPORT

Including: River Resource Data;

Background on Groundwater, Aquifers, Wetlands, Floodplains, and Wildlife;

Methods to Quantify Groundwater Vulnerability, Wetlands Values, and Wildlife Diversity;

Suggested Three-town Coordinated Ordinances.

by

Mary Rosenfeld

for the

Friends of the Kennebunk River

1986

Financial asistance for preparation of this document was provided by a grant from MAINE'S COASTAL PROGRAM, through funding provided by the U.S. Department of Commerce, Office of Ocean and Coastal Resource Management, under the Coastal Zone Management Act of 1972, as amended.

The Kennebunk River between Perkins Road and Days Mills.

ACKNOWLEDGEMENTS

Because of the recent concern with growth in York County, this has been a fortunate time to carry out the Kennebunk River Study. Gro Flatebo, Jean Scudder, and Holly Dominie of the Maine State Planning Office were of invaluable help in providing access to all the York County Cumulative Impact Study Data as it was being generated. Diane Hankenson went to a special effort to produce digitized land use data from the Department of Conservation. Andrews Tolman, and particularly Craig Neal, both of the Maine Geological Survey, took the time to help provide newly generated DRASTIC groundwater data, updated soil maps, and copies of background material on York County aquifers and geology.

Within the Department of Environmental Protection, thanks go to Fred Michaud for reviewing problems of floodplain definition, Rich Baker for reviewing shoreland zoning requirements, and John Sowles and David Courtmarche for their assistance with water quality interpretation. Thanks also go to Joan Trial of the Department of Transportation for finding and sending library materials on wetland assessment, and to Gary Donovon and Mark Stadler of the Department of Inland Fisheries and Wildlife for copies of wildlife reports related to shoreland zoning. Peter Veneman of the Department of Plant and Soil Sciences of the University of Massachusetts/Amherst deserves thanks for his time reviewing hydric soils and problems of wetland identification.

Contract administrator Sherry Hanson of the State Planning Office deserves particular appreciation for guiding us through the granting process and providing efficient and gracious help when needed.

Thanks also go to Rebecca Seel of the Maine Municpal Association for legal review of the ordinance package, and to Nancy Anderson of the Maine Audobon Society for review and comments on the wetlands ordinance.

On the regional level, appreciation goes to Dan Fleishman of the Southern Maine Regional Planning Council for the recent reports and statistics on the demography of 9 York County towns and the initial work on the Shoreland Zoning Ordinance.

Working with the personnel at the town halls has been particularly enjoyable and informative. Thanks go to town manager Rick Erb, planner Judy Bernstein, assessor George Giddings, assistants Barbara Welch and Jean Hamlin, CEO Mike Nugent, and to Sally McKay, Kathy Noette, Wanda Seegel, and Karen Mercier of the office staff in Kennebunk; to town manager Jane Duncan, town clerk Carles Gould, and staff Lorraine Brooks and Arlene Nowell in Kennebunkport; and to clerk Lucy Bigger, treasurer Therese Cliche, and selectman Louis Bergeron in Arundel for their good humor and help.

Appreciation is also extended to the three town planning boards, to the Kennebunkport selectmen, to the Kennebunkport Growth Committee, and to the Kennebunk Conservation Commission for taking the time to view the visual presentations, inspect the resource maps, and review the ordinance package in the midst of already overcrowded schedules. Dorothy Stevens, selectwomen of Kennebunk, deserves special appreciation for her support of the Study from its beginnings.

Special thanks also go to Gale McCullough, who started The Friends of the Kennebunk River in 1984, and who has supported the grant idea from its inception. Appreciation is also extended to Gale, Kevin Flynn, Phil Sawyer, and Fran Shaw who spearheaded the River testing throughout the grant period. Board members Tom Bradbury, John Bradford (legal counsel), Cate Cronin, Kevin Flynn, Susan Kane, Lyman Page, and Fran Shaw as well as Kennebunk citizen Al Adams and River Commission member Charlie Bassett deserve thanks for their useful input on the ordinance package.

Special appreciation is also extended to all the members of the River Commission; Gordon Ayer (legal counsel), Charlie Bassett, Dave Billings, Ben Emery, John McKay, Wayne Showalter, Phil Sawyer, and Henry Tilton for their review and support of the Study throughout the year.

Thanks also go to Ruth Landon for her review of colonial history on the River, Joyce Butler from the Brick Store Museum for her expertise and assistance on River history, Tom Bradbbury for his overview of historical changes over time, and Dave Bernstein of New England College for sharing photographs and data on archeological history related to the River.

Finally, the Friends of the Kennebunk River would like to dedicate this study to Tad Dow, whose enthusiasm, good humor, graciousness and political acumen provided much of the early impetus behind the grant project.

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INTRODUCTION

This report is written about the Kennebunk River System and the natural resources which affect it.

The report is written so a citizen can look up any one section and gain basic background information on that subject. Some examples of these topics include: changes in growth in the three towns; commercial uses on the River; the relationship between wildlife diversity and development on the River; and background information on wetlands and their identification.

It is also a study with an end product. A set of suggested protective ordinances co-ordinated between the three towns is given at the end of the study, as well as long-range planning recommendations.

This Coastal Zone Management Grant was awarded jointly to the three towns of Arundel, Kennebunk, and Kennebunkport, as the Kennebunk River serves as a common boundary between them. The towns hired a private citizens group, the Friends of the Kennebunk River, to carry out the study. Richard Erb, Town Manager of Kennebunk, served as Project Manager, and the three town River Commission supervised the project.

The study was designed to accomplish four major goals:

1. Photodocumention and field work along all of the trunk of the River and its major tributaries;

2. Resource data collection and mapping of land development, aquifers, DRASTIC groundwater categories, soils, wetlands, floodplains, wildlife diversity, historic sites, and property ownership;

3. Local presentations of a suggested ordinance package co-ordinated between the three towns;

4. A final report.

This final report is meant to be a basic, practical quide for town officials and other interested citizens. It describes the Kennebunk River System, the natural resources related to river systems (wetlands, floodplains, groundwater, aquifers, wildlife, and scenic diversity), and offers a package of suggested ordinances to protect river resources.

One set of resource maps will be given to each town with this report. The slide collection will be stored with biologist Cate Cronin of Arundel; each set of slides used in individual town presentations this year have been labled and stored consecutively for future use.

The author is a biologist with a background in planning, and welcomes any questions regarding the study. She can be reached at 32 Oakland Avenue, Arlington, MA 02174 or at 617-646-1974.

SUMMARY

In 20 years, Arundel and Kennebunkport will double in size, and Kennebunk will triple in size at their present growth rates. The growth in population is due almost entirely to in-migration and not to an increase in town birth rates (pp. 5-8).

The lower Kennebunk River reflects present growth and change. In 1986, the following businesses and activities occurred directly on the lower River: 7 restaurants and cafes with 709-809 seats; 5 hotels or motor inns with 139 units; 42 shops and galleries; seven commercial marinas with 230-240 berths; 8 commercial cruise/deep sea fishing boats with a capacity of 375 passengers/day; and 361 larger moored boats (52% motor boats, 38% sailboats, 10% commercial boats).

It is estimated that two thousand recreational boats visit in the summer, bringing approximately 5000 people. Chick's Marina alone registered 680 transient visitors in the summer of 1986 (pp. 27-28).

The entire length of the Kennebunk River and its tributaries in the three towns was checked in the field and photodocumented. The results show a wide variety of scenic and wild diversity - from old beaver ponds to falling rapids - that remain unknown to most citizens.

This photodocumentation is locally available (p. 1).

Among town residents, a strong interest in the outdoors and wildlife is indicated by the fact that 14%, or one out of every seven townspeople, buy a hunting, fishing, or combined liscence. The majority of these are for local use (pp. 28-29).

Groundwater supplies an important major source of local drinking water. A recent local study by the Maine Geological Survey shows that almost all land in the three towns is "not very well protected" or "highly vulnerable" to groundwater contamination (pp. 36-37).

Wetlands play an important role on the Kennebunk River and other local river systems for substantial flood control, spring nutrient release to aquatic organisms, pollution control, and wildlife diversity and abundance (pp. 40-43).

Floodplains hold and control substantial floodwaters every year in the three towns.

For example, a winter thaw early in 1986 caused flooding 4-7 feet above the normal water level along the Kennebunk River System, covering entire floodplains often hundreds of feet wide, even in the upper reaches of the tributaries. The flooding was marked by standing ice shelves that persisted throughout the rest of the winter.

Also, new and full moon tidal waters regularly cause flooding 9-10 feet above low tide levels as much as 5 miles upriver on the Kennebunk River, completely covering tidal floodplains (pp. 46-49).

The normal high water mark used to delineate shoreland zoning setbacks should be taken from the normal high monthly and annual flooding boundaries mentioned above.

Testing results show the Kennebunk River System is still remarkably clean and maintains good levels of oxygenation important for aquatic life. Coliform levels below Class B river standards are believed to come primarily from cow manure. The DEP will be testing these areas and then working with the Soil Conservaton Service to make recommendations to farmers (p. 34).

The number and variety of wildlife along the Kennebunk River System goes up geometrically the greater the distance from the nearest residence (pp. 54-56). There are still areas of high wildlife diversity left in each town which can be preserved using long-range planning techniques even while growth continues (pp. 58-60 and 67-72).

River corridors, particularly if they connect to larger blocks of open land, are the most heavily used and valuable environments for mammals and birds (pp. 56-58).

River wildlife corridors supply drinking water, a wide variety of food resources, and show the most intense bird and mammal breeding use of any environment. Rivers also serve as furbearer traveling corridors and provide tempered winter protection for deer.

Long-range town planning, and protective ordinances, would allow the rural Maine character, wildness, scenic diversity, and natural resources of this area to be protected while growth continues.

To this end, ordinances for shoreland zoning, wetlands and groundwater protection, and the elimination of overboard discharge are given on pp. 73-86. A summary of the rationale for each ordinance is given on pp. 62-66. Recommendations are also made for controlled growth, new methods of site review, and natural resource planning on pp. 67-72.

Local citizens can indeed take control of their own communities to preserve all of the richness, diversity, and beauty that is still present in these three coastal towns. With the use of long-range planning techniques, attractive and suitable housing and other amenities for the use of local townspeople can also be integrated with this preservation.

GROWTH AND CHANGE

Growth in York County and the Three Towns

High regional employment, and the recent desirability of southern coastal Maine as a retirement area, are changing coastal York County towns from quiet, primarily rural villages to rapidly expanding bedroom and retirement communities. York County grew 20% from 1970-80 compared with an average rate of 13% statewide. The 5 coastal towns from York to Kennebunkport plus Alfred, Arundel, Lyman, and Sanford experienced an average rate of increase of 64% during this time (Dominie and Scudder, 1986). Growth figures and future estimates for York County are shown below (Fleishman, 1986):

YORK COUNTY POPULATION GROWTH

Pop. 1970	1970-80 annual growth rate	Pop. 1980	1980-86 annual growth rate	Est. pop. 1990
116,388	(2.0%)	139,666	(3.47%)	193,445

These increases are also reflected in the past and projected growth rates for Arundel, Kennebunk, and Kennebunkport (Fleishman, 1986; SMRPC, 1986):

POPULATION CHANGE AND ANNUAL GROWTH RATES 1970-86
IN ARUNDEL, KENNEBUNK, AND KENNEBUNKPORT

	pop. 1970	1970-80 annual growth rate	pop. 1980	1980-86 annual growth rate	est. pop. 1986	est. pop. 1990
ARUNDEL	1322	(6.26%)	2150	(3.50%)	2602	2986
K'BUNK	5646	(1.73%)	6621	(5.16%)	8669	10601
K'PORT	2160	(3.67%)	2952	(2.65%)	3421	3898

Given the present growth rate, Arundel will have grown 2.3x from 1970 to 1990, Kennebunk 1.9x, and Kennebunkport 1.8x. However, Kennebunk's growth rate has been increasing; it was 2.9 times greater in 1980-86 than it was in 1970-80, while Arundel's rate declined 44%, and Kennebunkport's declined 27%. For the period 1980-86, Kennebunkport was 22nd in growth, Arundel 18th in growth, and Kennebunk was tied for 6th place with Old Orchard Beach among the 29 towns of York County.

In an article in the York County Coast Star (10/10/86), SMRPC planner Dan Fleishman noted that a growth rate of more than 2% a year will strain local government resources. As shown in the chart above, there is a present growth rate of 3.50% in Arundel, 5.16% in Kennebunk, and 2.65% in Kennebunkport. On top of this growth pressure, populations in this area expand 2-3x during the summer months, further straining the towns' resources (Dominie and Scudder, 1986).

As a consequence of this rapid growth the three towns have passed updated zoning and subdivision regulations over the past 25 years in order to regulate aspects of development. Comprehensive plans have been written for each town which note the importance and value of natural resources, but little actual protection exists for any of these resources beyond what is presently mandated by the state.

Now it is apparent that many of the natural resources that have been taken for granted as part of the quality of life in Maine are being altered or lost. These natural resources include uncontaminated groundwater; unspoiled wetlands for waterfowl, water recharge, and flood control; unspoiled rivers, lakes, and coastal beaches for recreational enjoyment and wildlife use; protected wildlife habitat; peaceful scenic diversity; and unpolluted air. Natural resource concerns related to the health of the Kennebunk River and other river systems will be addressed in this report and ordinances for their protection will be listed and explained.

Development on the Three Towns' River Systems, 1970-85

As land has disappeared along the coast, developers have increasingly turned to acreage which lies along inland rivers and lakes. A list of all subdivisions in the three towns which were granted permits from 1970-85 (SMRPC, 1986) was used to identify those developments which occurred along rivers. The plans were then examined at the Registry of Deeds in Alfred for the number of units and the acreage in each development. This information is summarized on the next page (for the complete listing see Appendix A).

NUMBER OF SUBDIVISIONS, TOTAL UNITS, TOTAL ACREAGE, AND DENSITY ON TOWN RIVERS, 1970-85

	Subdiv. on rivers/total subdivisions	Total units on rivers	Total acreage on rivers	Units/ acre
ARUNDEL	7/26 (27%)	34	133	1/3.9
K'BUNK	14/55 (25%)	400	330	1/1.2
K'PORT	4/23 (17%)	41	184	1/4.5
TOTAL:	25/104 (24%)	475	647	1/1.7

During this time, therefore, approximately 1/4 of the subdivisions were built on rivers. Fifty-six percent of the river subdivisions and 84% of the units were built in Kennebunk. Kennebunk also had 3.5 times the density of units along rivers as Arundel and Kennebunkport (1 unit/1.2 acres vs. an average of 1 unit/4.2 acres). Thirteen subdivisions (52%) were built on the Kennebunk River System, 8 on the Mousum River System (32%), and 4 on the Batson River System (16%). Since these figures were compiled the 640 acre Alewife Farm which encircles most of Alewife Pond and part of Wards Brook (both part of the Kennebunk River System) has been purchased for development.

The DEVELOPMENT MAPS show the extent of the different kinds of development which has occurred in each town. In terms of river systems, total development has been greatest along the Kennebunk River and its tributaries, and on the Mousum River.

Arundel has low density development along the Kennebunk River up to Rt. 1. A Kennebunk River tributary, Duck Brook, has periodic development varying from high to low density along its upper half. Goff Mill Brook has primarily low density development occurring sporadically along much of its length.

In Kennebunk, the lower 5 miles of the Kennebunk River combine light and heavy residential and commercial development. The Kennebunk river tributary Wonder Brook is now developed at each end, and while Ward's Brook, which is wild throughout most of its length, will be developed near Alewife Pond. The Mousum is heavily developed around its central core, and is relatively undeveloped elsewhere. Branch Brook remains free of any major development.

In Kennebunkport, very heavy commercial and residential development exists around the Lower Kennebunk River to the Kennebunk River Basin, than heavy residential development continues up to the Arundel Golf Course. The towns's major river system, the Batson River, is relatively undeveloped.

The New Residents and their Reasons for Living in Maine

How much of the population increase is due to the natural birth rate within the three towns, and how much is due to outsiders moving into the area? The answer is surprising - of a total of 2955 additional residents from 1980-85, 2873 or 97% represented new residents moving in from outside the towns (resident births did occur in Kennebunk and Kennebunkport but were outnumbered by deaths; SMRPC,1986):

NATURAL BIRTH RATE VS. IN-MIGRATION IN THE THREE TOWNS

	1980-85 natural increase	1980-85 in-migration
ARUNDEL	82	370
K'BUNK	-29	2077
K'PORT	-39	508

The Cumulative Impact Study states that "The quality of life which Maine offers is responsible for recent unprecedented growth. New businesses, retirees, summer residents, and 'escapees', primarily from southern New England, are coming to Maine in search of a better living and working environment". (Scudder, 1986).

Seventy percent of these immigrants placed high priority on enjoyment of woods and rural areas; 74% considered enjoyment of the natural environment highly important; 55% wished to get away from corporate and/or suburban living; and 47% looked forward to water-related activities (Scudder, 1986).

Will the influx of new residents make the very qualities they're seeking disappear? Or can there be a balance between growth and the preservation of natural resources? This study will address the possibility of balancing both.

THE KENNEBUNK RIVER SYSTEM

The Kennebunk River and its tributaries reach into 4 towns: Kennebunk, Kennebunkport, Arundel and Lyman.

The main trunk of the River and its tributaries cover a watershed area of 52.88 square miles within these towns (see WATERSHED MAP).

Basically, that means that all rain or snow that falls over this area and isn't evaporated, absorbed, or redirected (i.e., through storm culverts, etc.) ends up eventually running into the Kennebunk River. Thus the quality of the River depends on the quality of all the small streams, wetlands, and tributaries that run into it, and the quality of those smaller waterbodies depends on the health of all the surrounding land from which their runoff occurs.

All land is part of some watershed; in Kennebunk for example, any land which doesn't lie within the Kennebunk River watershed has to lie within the Mousum River or the Branch Brook-Little River watersheds. Thus the quality of all river systems everywhere depends on the health of the total environment.

Other significant watersheds in the three towns are the Batson and Little River watersheds in Kennebunkport, and the Saco River watershed in Arundel.

The main trunk of the Kennebunk River serves as the boundary between the coastal towns of Kennebunk and Kennebunkport for approximately 2 miles, and then becomes the boundary between Kennebunk and Arundel for 10 miles until these towns' borders end at Days Mills. The River extends into Lyman approximately 1 mile and then divides into Carlisle Brook and Lords Brook. Sunken Branch Brook divides off Lords Brook 1 mile further north.

Sunken Branch Brook and Lords Brook extend northwest and north respectively, each ending up on opposite sides of the 238 acre Kennebunk Pond. Waters from Kennebunk Pond flow out in an unusual pattern from both the east and west sides (the East and West Outlets) into these tributaries. The tributaries finally end approximately 1 mile north beyond the Pond outlets.

Altogether, the total length of the main trunk of the Kennebunk River and all its major tributaries is 78 miles. The total length of the Kennebunk system within the 3 towns in this study is 53 miles.

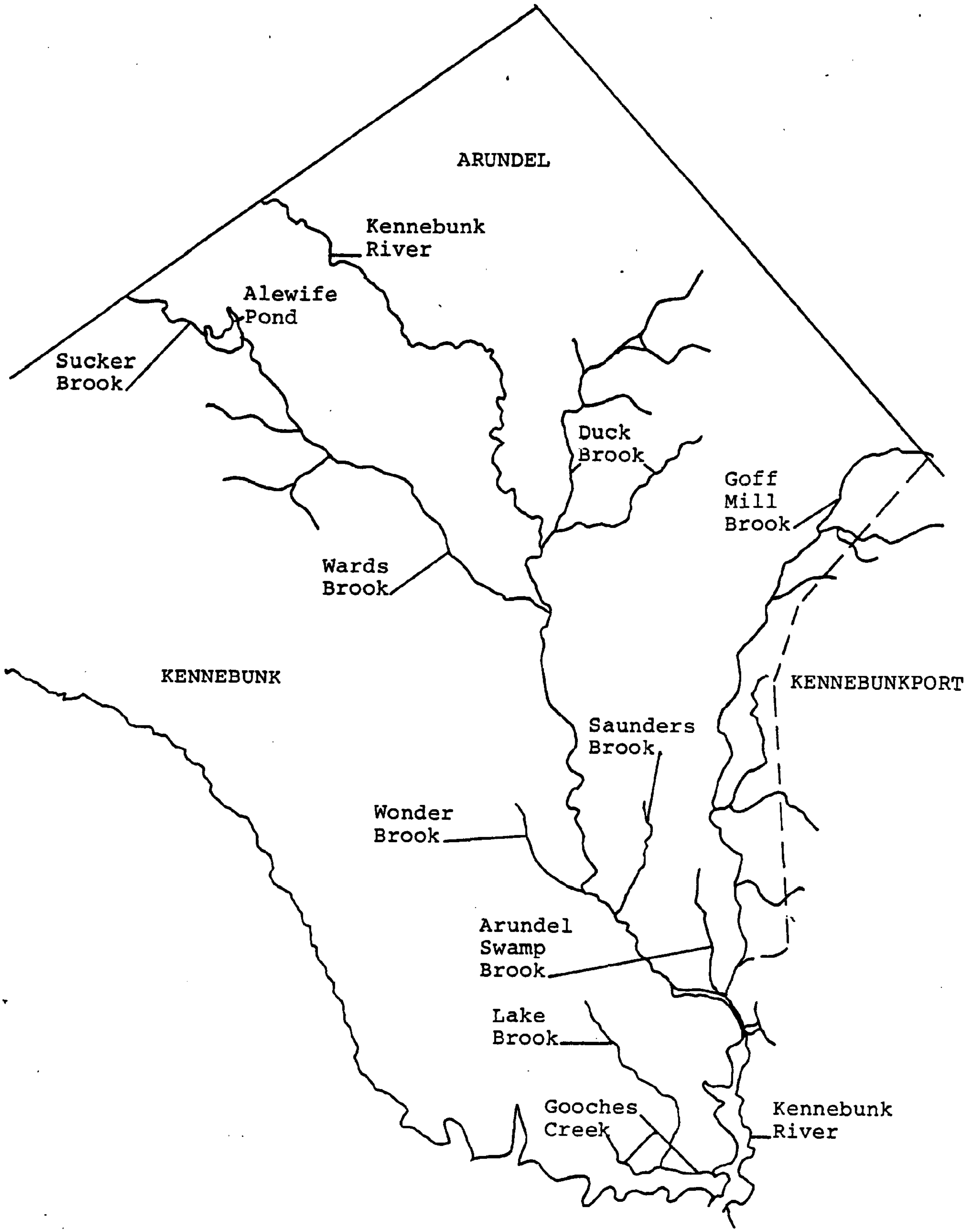

Fig. 1. The Kennebunk River and it's tributaries in the three towns.

The geography, hydrological character, scenic variation and animal and plant diversity are summarized for the main trunk of the River and for each major tributary in the next section.

The Hydrology, Geography, Scenic Diversity, and Wildlife Diversity of the Kennebunk River and Its Tributaries

The Main Trunk of the Kennebunk River

Hydrology

The Lower River, from the ocean mouth to the Route 9 bridge, is where the major commerce of the River takes place (for a description of this activity see Commercial and Recreational Uses on the River). Commercial use is concentrated here because of the low bridge clearance at Route 9 and the shallow channel upriver of that point.

The Lower River is a little over a mile long and averages 400' across, with a minimum width of 100' and a maximum width of 900'. A Federal Navigation Channel 5500' long is maintained by the Army Corps of Engineers down the length of the River to within 160' of the Route 9 bridge. This Channel is 8' deep at the entrance and 6' deep in the inner harbor; it is 100' wide for the first 4000' of its length and 75' wide the rest of the distance (Tomey and Bajek, 1984).

Tidal movement through the channel is relatively strong with the current ranging from 0.2-2.3 knots in either tidal direction (Tomey and Bajek, 1984). The mean tidal rise is 8.6' and the tide moves approximately 6 miles upriver to the general vicinity of the old Indian Planting Grounds (see HISTORIC MAP). The tides move further upstream during the higher monthly tides but are eventually blocked by the rise in elevation that occurs before the rapids at the Route 1 bridge.

High tides 1' above normal occurred an average of 7 days/month in 1986, while those 1.5' or more above normal occurred an average of 4 days/month in 1986. Higher than normal tides are associated with both the new and full moons (Eldridge Tide and Pilot Book, 1986).

These higher than normal tides have a profound effect on areas upriver. Photographs were taken of Wonder Brook, which is 4.8 miles upstream, at low tide and again during a new moon high tide. The tidal rise plus the back-up of the normal runoff raised the water level an estimated 10.5 - 11 feet above the water channel.

Flooding can also be caused by storm events or ice-jams. Winds from the September '85 hurricane struck the coast during a low tide period, and had the effect of raising waters to normal high tide levels. If this had happened during a normal high tide period, a wall of water an additional 9 feet high would have moved upriver, far surpassing the flooding potential of the 2+ feet seen during the annual spring tides.

Ice-jams can form as well, particularly at Durrells Bridge. Here the River is narrow enough for ice to form; once formed it expands, cracks and buckles, and these uneven sheets can then be moved about by the tides to create ice-jams.

Geography, Scenic Diversity, and Wildlife Diversity

The Lower River is attractive and full of activity but sites of visual access are increasingly being closed off in the commercial areas. Areas open to the public include Government Wharf near the mouth of the River in Kennebunkport, Parsons Beach off the East Jetty, Gooch Beach off the West Jetty, and the Monastery land on the Kennebunk side belonging to the Society of Franciscan Fathers. The Monastery land extends 1/2 mile along the shoreline: there is a path which runs its length through magnificent woodland, with vistas out to the River across extensive saltmarsh. At the south end a raised path continues out to the "boathouse", a circular, roofed structure with open sides and a broad view out over the saltmarsh to the Lower River and Gooches Creek.

The Monastery is by far the richest site on the Lower River for wildlife diversity. A trip down the River in a rowboat emphasizes the contrast between this untouched stretch and the riprapped, commercial Kennebunkport area. While a few mixed domestic ducks use the Kennebunkport side, the Monastery is rich in wildlife. Great blue herons, snowy egrets, and smaller shorebirds use the monastery coves and saltmarsh flats to find fish and invertebrates, and mallards and herons use partly submerged trees as resting and perching places. Salt pans dot the saltmarsh and active trails are maintained by raccoons and occasional foxes. In the fall the saltmarsh edge is thick with blooming seaside goldenrod and saltmarsh asters which attract migrating monarch butterflys.

The Monastery land includes wild woodland at its south end, and is located near other wild areas: woodland and saltmarsh continue down Gooches Creek to the west, and a relatively undeveloped shoreline stretch of private land with bulrushes, second growth woods, and sand dunes extends from Gooches Creek to Gooch Beach. These areas provide a remarkable contrast to the crowding and hectic pace maintained on most of the Lower

River.

Immediately north of the Route 9 bridge the River expands into the 700' wide Kennebunk River Basin, where the last of the commercial buildings occur. From here to Durrells Bridge, houses are seen periodically along the shoreline but the dominant effect is of the 100-200' wide River itself, winding past mature pine woodlands and open saltmarsh floodplains.

Old pilings from one of the nineteenth century shipyards at the Kennebunk Landing are visible protruding out of the sides of the banks just above Durrells Bridge; from here the River winds in great wide loops past banks thickly overgrown with wild shrubs and occasional trees backing up on fields with a profusion of wildflowers. Rich extensive saltmarsh floodplains fill the loops between the banks. This is wildlife habitat; a variety of mammals as well as kingbirds, warblers, owls, and a marsh hawk make their homes here.

The River continues past the Riverwynde development in Arundel and the entrance to Wonderbrook and then straightens. The last big loop at Wonder Brook is now a freshwater floodplain; the River now continues straight ahead between low banks, spilling down past fallen snags and over a rocky bottom. Large-canopied black oaks and white pines line the edges.

North of the Boston and Maine Railroad the River meanders again, bending around the old Indian Planting Ground at the head of tide and continuing through a thick and wild profusion of second growth woods. Here the rapids become more noticeable; water spills over and around larger rock outcrops, and large gravel islands covered with arrowheads, cardinal flower, Joe-Pye-Weed and wild mint lie interspersed with rock outcroppings in the River channel.

Before the Route 1 bridge development encroaches again; some of the condominiums of the new Powder Mill subdivision are crowded against the banks of the River; rolls of fiberglass insulation and other debris sit soaking in the water.

At the Route 1 bridge different layers of rock outcrops have caused a set of dramatic, stepped, rushing rapids next to the remains of a colonial mill. North of the bridge a large cleared area on the Kennebunk side reflects the recent extension of the business district zone to the River. Shortly north of this area, however, the River enters a long, relatively wild stretch surrounded by mature mixed forest and occasional wild fields. Here snowy owls and pileated woodpeckers can be seen, as well as the winter tracks of a cross-section of mammals. Wards Brook divides off above Punky Swamp through a dense tangle of second growth brush bordering a field which will be developed (4 lots).

Three quarters of a mile further north Duck Brook branches off into Arundel just before the Old Railroad Grade Crossing. The River here now becomes rich in water plants - pickeralweed, arrowheads, yellow pond lily, and bur-reeds; reflecting the influence of increased nutrients from the dairy farms further upriver.

The River is now only 20-30' wide, and breaks up into smaller meanders with pockets of aquatic plants along the sides. Trees overhang the River; some are uprooted and have fallen across it; sunlight reflects off the water in patches through the leaves. This stretch between Duck Brook and the Maine Turnpike is full of animal trails; woodcock fly up sporadically from along the River bank.

From the Turnpike to Perkins Road, much of the Kennebunk is bordered by farms on one or both sides. The occurrence of frequent wild fields, woods, and steep, thickly grown banks along the River helps provide protection for wildlife between the more intensively farmed areas. The topography of the River is often dramatic; bending in sharp curves through steep banks tangled with overgrown thickets of wild clematis, jewelweed and bedstraw, and overspread by oaks or sugar maples.

North of Perkins Road the River winds past several large cow pastures. The River widens out here and forms much larger meanders past alternating high, steep clay banks and wide floodplains most of the way to Days Mills. Cows use the first section of the River extensively and their hooves have trampled out paths along the banks and along the River's edge and floodplains.

As the farmland gives way to woods, wildlife immediately becomes more evident. This area is both botanically and scenically rich. Hemlocks are the dominant trees along these high, shaded banks, and are interspersed with oaks, pines, and yellow birch. Swamp dogwood, alders, and buckthorn extend out on small, gravelly floodplains. The sweeping curves of the River bed are interspersed with round granite cobbles from one to six feet across, and occasional mid-stream areas of bur-reeds. A dramatic group of rock outcrops and rapids occurs approximately half-way to Days Mills.

The River finally straightens on the last stretch, divides around a large hemlock island, and continues under Route 35 to the dramatic dammed falls at Days Mills.

In summary, the Kennebunk River is a river of great scenic beauty, with significant wild areas surrounding it. It varies greatly in character depending on the wildness of the land around it, the surrounding topography, the additional water volume entering the River from each tributary, and the daily tides. It is a remarkably well-preserved, healthy, wild River. Protective efforts and planning can keep it that way.

Tributaries in Kennebunk

Gooches Creek-Lake Brook

Gooches Creek branches off the Lower River 1/4 mile north of the River mouth, and winds through approximately 80 acres of saltmarsh. This 140-210' wide tributary divides into two subtributaries in the middle of this wetland. One heads southwest across the marsh and then westerly across Boothby Road and through a series of well-maintained ponds and culverts on the Webhannet Golf Course, then across an area being developed to Route 9. The rest of the tributary sweeps sharply north, crosses under Route 9, and continues as a wild river for 1.8 miles.

Salt marshes are areas of high estuarine productivity and also supply invertebrates and fish to resident and migrating birds and to mammals. Because salt marsh areas are quite limited along Maine's rocky coast, this large saltmarsh has a special significance.

Its use by wildlife is quickly apparent. Shallow saltwater filled depressions called saltpans provide a rich habitat for minnows and invertebrates, which are in turn eaten by wading birds, shorebirds, and mammals. The soft mud sides of an evaporating saltpan make excellent impressions, and the rich array of fox, raccoon, great blue heron, snowy egret, and small shorebird tracks can be readily seen. This is particularly evident on the northwest side of the marsh where there is a large buffered woodland area, and along the old railroad grading which angles across the center of the saltmarsh.

The entire southern side of the marsh is heavily developed but development is only beginning on the east and west sides. Basically, wild animals need privacy and cover; the animal life on the marsh is therefore presently more concentrated around the middle and northern sections. Keeping development back from these wild shorelines and preserving the buffer woodland area to the northwest (mentioned above) is essential to preserving the present wildlife diversity.

Gooches Creek, now known as Lake Brook, heads northwest from Route 9 and continues for another 1.8 miles through an almost undeveloped area. From Route 9, the Brook continues through a narrower section of saltmarsh plain dotted with saltpans, which periodially expand out into larger ponded areas as it heads north. The wetland edge is surrounded by bayberry, highbush blueberry, arrowwood, goldenrods, and grasses, with red maples behind. Beyond the ponding areas the tidal waters become more dilute, and the saltmarsh grass Spartina patens is now mixed with salt tolerant freshwater grasses. Now the Brook narrows to 2-3' and meanders across low, green, freshwater marsh, finally entering a saturated alder swamp and continuing into red maple and upland woods. Many smaller tributaries feed from this headwater area into Lake Brook.

The entire Lake Brook area is undisturbed and thick with animnal paths. Deer tracks are common at numerous crossings over the Brook. Herons are found on the marsh and snowy owls inhabit the woods. This wild, beautiful, and still undeveloped area deserves the same protection as the contiguous Gooches Creek saltmarsh.

Wonder Brook

Wonder Brook divides off the Kennebunk River 4.8 miles upriver and heads northwest into Kennebunk for 1.8 miles. The Brook enters into a wide, tidal, floodplain area, then winds upstream through thick, mature forest which slopes down from high banks. North of the B&M railroad tracks there is cleared stretch of private land, then the Brook continues through lower woods and wetlands to the open fields behind the Route 1 shopping area. It then continues on through high density residential development. The head of tide is approximately 0.25 miles upstream of the Brook's entrance off the Kennebunk River.

The lower half mile of Wonder Brook has some spectacular features: the green expanse of tidal sedge wetlands dotted with wild iris and wild morning glory, steep uplands with mature, dark forest with large oaks and some very old white pines (up to 4.5' in diameter), tall stands of woodland wild valerian, and the frequent sounds of thrushes and ovenbirds in the woods. The northern coralroot is found here and hummingbirds feed on the jewelweed along the Brook.

Many developments are now encroaching close to this part of Wonder Brook, and several dirt access roads have been cleared into the woods. The land immediately north of the railroad tracks has been entirely clearcut to the edge and has some bulldozer and 4WD damage along the banks. At least 5 rusted oil drums lie in the Brook channel behind the Route 1 shopping area. In spite of these problems, almost all of lower Wonder Brook is still very beautiful and wild, and protective measures (see SUGGESTED THREE-TOWN ORDINANCE PACKAGE and Larger-Scale Planning for Wildlife Diversity) could continue to keep it that way.

Wards Brook - Alewife Pond - Sucker Brook

Wards Brook splits off the Kennebunk River 8.2 miles upriver and then heads northwest 7.7 miles to enter Alewife Pond. Alewife Pond is one of Kennebunk's Great Ponds (the other is Old Falls Pond on the Mousum River) and is approximately 40 acres in size. Sucker Brook exits out the west side of the Pond and ends just beyond Cole Road 0.8 miles later.

Of all the Kennebunk tributaries, Wards Brook is by far the richest in wildlife diversity. This is due to a dense woodland with varied canopy layers and a great deal of cover, an extensive, very rich wetland around the central core of the tributary, and, most of all, to its remoteness from residential development. In this study, there has been a direct correlation between the inaccessability and remoteness of an area from human habitation and the increasing extent of its wildlife diversity (see Wildlife Diversity and Development: an Inverse Correlation).

With the 640 acre Alewife Pond Farm now being subdivided around Alewife Pond and the upper section of Wards Brook, this wild status may change. Measures to substantially buffer Wards Brook and its surrounding woodlands from the effects of development would help preserve the wildness downriver.

As Wards Brook divides off the Kennebunk River it enters a rich tangle of second growth for 1/4 mile, then runs through cow pasture much of the way to the Maine Turnpike. Cows have heavily trampled parts of the banks and aquatic plants completely fill the Brook in places due to fertilization by manure. However, once beyond the pasture the Brook is immediately used by wildlife; concentrated deer and raccoon tracks line parts of the banks, and the wildlife signs continue in profusion throughout almost all the rest of the tributary.

From Route 35 westward Wards Brook travels through mixed open woods and then passes through approximately 1/2 mile of extensive, rich wetland. Beavers have been trapped out of the area but a pond of approximately 20 acres filled with fish and waterfowl was formed on one of the side tributaries by beavers three years ago (R. McKay, pers. comm.). This has now mostly drained away. There is also recent beaver evidence along other sections of this wetland.

The Brook continues on twisting and meandering through mixed young woods rich in a variety of trees, shrubs, and herbaceous plants; here the bottom clay and sand bars are filled with the impressions of a wide diversity of mammals.

Within a few feet of Alewife Pond the wildlife signs end abruptly; much less evidence of eithor terrestrial or pond wildlife exists on any side of the Pond. This is probably due to the access to the Pond on a number of 4WD roads, and its use by weekend fishermen and campers. This is evidenced by occasional campsites along the Pond's edge which are littered with charred firewood, tin cans, beer bottles, and the remains of tents.

The Pond itself supports substantial border wetlands ranging from woolgrass-cattail marshes to sedge marshes to emergent pickeralweed and arrowhead areas. It also supports a variety of plants found in deeper water such as wild celery and several species of water lilies. Vegetatively, it provides an excellent variety of plants for wildfowl, yet few ducks or geese are found here. The Pond is locally known as a good fishing site.

Sucker Brook continues westward from Alewife Pond and runs through very thick underbrush and a mix of different aged trees. This wild area is dotted with small wetlands and ponds. Wildlife diversity is lower here than would be expected from the lush growth and cover. The Brook continues across Cole Road and enters a wetland area.

Tributaries in Arundel

Goff Mill Brook

Of all the tributaries, Goff Mill Brook has the greatest scenic attractiveness and the most scenic diversity. This 8 mile Brook with its many feeder tributaries also contributes by far the greatest water volume into the Kennebunk.

Substantial spring melt can occur in Goff Mill Brook. This is evident by the occurrence of piled up snags, undercut banks, and scoured floodplains along the lower Brook as well as by the double 12' culverts on Sinnott Road and the flooding over the 8' banks at the Fran-Mort Campground.

Goff Mill Brook begins as a 120' wide riverway north of the Arundel Golf Club, passing eastward through brushy banks and past mudflats frequented by feeding shorebirds. The Brook passes under River Road, and then rises approximately 4 feet in elevation due to the existance of an old dam.

The view of Goff Mill Brook south to the Kennebunk River from the River Road bridge is one of the most scenic in the three towns. Remains of the old Goff Mill are still fairly intact here; fitted rock foundations extend out from each bank and 3 gristmill wheels can be seen among the rocks on the bottom at low tide.

North of the bridge the Brook passes into mature woods up to Sinnott Road. Here the topography varies dramatically, with low, densely vegetated brushy floodplains on one side alternating with high, steep, sometimes undercut banks on the other as the Brook twists and meanders. Large hemlocks and maples cling to the sides of the banks or have been undercut and have fallen across the River. The soil is rich here; all varieties of trees can be found, including beech, white ash, yellow birch, hemlocks, white pines, slippery elm, red maples and red and black oaks. Mushrooms spring up from the forest floor and a wide variety of herbaceous plants and wildflowers occur where the overhead canopy opens up. An active, temporary, vernal salamander pond with egg clusters can be seen in the spring.

The Brook turns and twists back on itself and eventually runs under Sinnott Road and past the Fran-Mort campground. It continues through a mix of old fields with high clusters of goldenrod and sumac, and then onward through immature and mature woods. The Brook character changes here; the topography is flatter and the Brook runs in riffles over a rocky bottom; small islands of tenuously attached shrubs appear in the river next to banks of overhanging alders and highbush cranberries ripe with berries. This mixed, wild stretch is rich in wildlife; this diversity diminishes somewhat as the Brook winds northward through darker, mature woods of of hemlock, white pine, black oak and red maple.

Approaching Log Cabin Road, the Brook widens out to several spectacular pools separated by rapids. Here sunlight filters through the overhanging canopies and reflects off the rushing water as it moves downstream. In the fall, colored fallen leaves are trapped in profusion behind moss-covered rocks along these pool edges.

Across Log Cabin Road the Brook winds through a very rich, diverse shrub marsh and then continues on past the Kennebunkport Trolley Museum into a winding stretch with mature, open white pine woods where fox and raccoon tracks can be seen. Eventually the Brook emerges near open farmland and passes under the Boston and Maine Railroad tracks into old fields. The Brook spreads out into a series of manmade ponds with small dams, edged with thick overhanging alder, viburnums, and red maples. Beyond this point the Brook spreads out and forms a wetland edge which eventually expands out into a series of beaver ponds. These ponds are the most dramatic wild feature of the Brook and are thick with wildlife. Warblers, kinglets, kingbirds, flocks of sparrows, waterfowl, kingfishers, marsh hawks, muskrats, raccoon and deer are all found here.

Goff Mill Brook is a tributary of much beauty and diversity, but does not support the variety or quanity of wildlife that would appear to be ably supported by the rich vegetation, cover, and variety of topography that is evident. This is probably due to its lack of remoteness; human trails, fishermen, and the popularity of the area for hunters may keep wildlife populations reduced. The closeness of some of the residences, and the Brook's proximity to Log Cabin and Biddeford Road, may discourage wildlife as well.

This lower diversity along parts of the Brook make the rich diversity around the beaver ponds particularly noticeable. Geologically the area changes here, with poorer soil interspersed between rocky outcrops, and extensive, somewhat stunted birch and poplars. When beavers created the ponds here they not only deepened and greatly widened the waterway, but created floodplains where soil deposition has created a much richer wetland environment than would have been evident without them. This vegetation and the ponds themselves create a rich wildlife habitat, which rapidly falls again in diversity beyond the pond system.

This wildlife diversity will not last in its present form, however, because the beavers are now gone; apparently trapped out of the area 3 years ago. If the area could be protected from trapping the ponds could be maintained (see Returning Beavers to the Area under WILDLIFE DIVERSITY). In fact, there is extensive enough poplar forest to maintain a good beaver colony over even more of the area; this would greatly add to the wildlife value of this part of the Brook.

The Brook continues through primarily wet red maple swamps until Proctor Road; across from the road the Brook's sides have been bulldozed and partly filled with demolition debris; neighbors claim this is presently sealed off from the original Brook drainage and that the last quarter mile of the Brook above this now overflows into surrounding fields. The filling is on the property of an auto body repair; there is good evidence that this property is also being used for toxic waste dumping.

Duck Brook

Duck Brook is the second largest Kennebunk River tributary in Arundel, dividing off the Kennebunk just before the B&MRR crossing and running 3.2 miles to Davis Pond. There it splits into two feeder tributaries each about one mile long; 3 other main tributaries enter Duck Brook lower down. The total Duck Brook system is 8 miles long.

Hydrologically, Duck Brook probably carries about 1/4 the water volume of Goff Mill Brook. Duck Brook varies from 6-25' wide most of the way to Davis Pond, and maintains this channel width throughout about 1/3 of its tributary length. It's flood potential is obvious by the frequent occurrence of wide, woodland floodplains, or of steep undercut cliffs in certain locations (i.e., immediately west of Limerick Road).

Duck Brook enters a tangled wetland as it leaves the Kennebunk River, and then continues on to the Maine Turnpike through floodplain forest with little understory. Summer deer tracks can be seen on the sand bars which line the channel as the Brook curves through overhanging red maples and hemlocks.

Between the Maine Turnpike and Downing Road the Brook runs through a cow farm with grass running right up to the Brook; the edge is well trampled by the cows and the Brook thickly vegetated from manure runoff.

North of Downing Road the Brook enters an extremely dense, rich woods where red cardinal flowers tower over banks thick with dense grasses and overhanging alders; after approximately 1/2 mile a 4WD road cuts down to the Brook and here extensive shoreline clearcutting has taken place. Most of this seems haphazard; thick piles of slash and fallen trees almost completely block parts of the Brook; slash and large branches lie in a tangle along the sides. Two 4WD roads cross the Brook; one has been built with only a board over the Brook and no culvert. One section of the Brook bank has been bulldozed and left exposed. A tire and household dump lie on top of one of the Brook banks.

North of this location the woods becomes wild again; this is a rich forest of mature white pines, red maples, and hemlocks amidst varied terrain; the channel runs between approximate 3 foot banks and carves a scenic passageway through overhanging maples. This section, and the tributary which divides off westward to the Dutch Elm Course support a relatively high wildlife diversity; this continues until the Brook comes within 1000 feet of the residential housing around Limerick Road.

East of Limerick Road, Duck Brook enters Davis Pond. This Pond is a shallow, approximate 4 acre pond that is well covered with tall emergent marsh plants such as cattails and woolgrass. This provides ideal waterfowl habitat with its protective hiding places and shallow, rich feeding areas; good numbers of mallards and wood ducks, as well as a great blue heron, have been seen feeding there in August. The back section of the pond is entirely grown in with a very rich, high growth of jewelweed, canary grass, woolgrass, cattails and sedges.

The two tributaries running off Davis Pond to the north and west are relatively low in wildlife diversity. The heavy residential development between New Road and the north tributary and new construction around the middle of the west tributary no doubt contribute to this. The forest is also thinned out and lacks substantial low protective cover. Bulldozing up to the brook's edge and heavy slash dumping in the Brook has occurred around the new home construction at the lower end of the south tributary. Both these tributaries are scenically quite attractive where human alteration hasn't taken place.

A 1.5 mile tributary of Duck Brook extends northeastward from Lower Duck Brook and runs roughly parallel to the old railroad grade. This is also a very scenic tributary, running through rich woods, but its closeness to the traveled railroad grade keeps wildlife away. The upper half of this tributary in particular has been scarred by heavy ATV or 4WD vehicle use and careless clearcutting. Roofing materials and other household and construction debris has been dumped periodically along the railroad grade.

Overall, Duck Brook is a largely invisable scenic resource which has much of the scenic diversity, attractiveness, and wildlife potential of the larger Goff Mill Brook. Town harvesting controls would protect the Brook from shoreland harvesting abuses, and creative cluster development away from the waterway will help maintain the wilder sections of the Brook.

Saunders Brook

Saunders Brook divides off northward into Arundel 1/4 mile north of Durrells Bridge. The Brook cuts through saltmarsh floodplain to a rocky outcropping, then heads through a small brushy valley surrounded by fields to River Road. From here it winds in a 6 foot, sandy-bottomed channel through open woodland and then marsh for 3/4 mile to an approximate 3 acre manmade pond. The pond is well-maintained and attractive, with open meadow along the earthern berm on the south side, and a variety of trees and diversity of topography along the rest of its length. Wildlife diversity is relatively high west of River Road and relatively low in the woodland, increasing again around the pond.

Arundel Swamp Brook

Arundel Swamp Brook splits off the Kennebunk 500 feet above the Arundel-Kennebunkport border. It enters a quiet, wide channel lined with white pines, weaves through an attractive saltmarsh wetland, and passes over rapids to cross under River Road. Here it enters a manmade pond, then travels along the edge of an overgrown field through an alder swamp into wet woodland for 1/2 mile of its total 1 mile distance. The wetland consists of red maples and white pines with raised roots over the wet terrain, small black spruce, and wetland shrubs and ferns; a few paths have been cut through the area for horseback riding.

All the features of this Brook are attractive; the entrance off the Kennebunk reflects white pines, asters, and goldenrod in its waters and provides a peaceful site to explore by canoe. Wildlife diversity is relatively high to the woods; the woodland wetland environment around the Brook is too saturated to provide easy traveling for mammalian wildlife.

Tributaries in Kennebunkport

Tributaries in Kennebunkport include Fairfield Creek, Chicks Creek, Gristmill Pond and its tributary, Bass Cove and its tributary, the entrance to Goff Mill Brook, and 1.5 miles of feeder tributaries into Goff Mill Brook.

Both Creeks, actually coves, lie off the Lower River and have been largely developed. Thick vegetation and rocky banks along the sides of both coves, and careful placement of residences make both coves attractive, quiet places for boating. There is some undeveloped land at each cove which adds additional variety and wildness to each site.

The Olde Grist Mill Restaurant is a landmark marking the entrance to Grist Mill Pond. Grist Mill Pond is actually a tidal inlet with a tributary which divides to the south through fields to the Consolidated School, and into rich woods to the north. The Pond itself is fairly rich in wildlife diversity, with great blue herons and snowy egrets feeding periodically on small schools of fish that come in with the tides. Wild, second growth borders the north side which grades into a mixed, mature forest with good undergrowth. Raccoon and deer tracks and trails can be followed here. Tidal flats border the pond and continue northward before the tributary divides. Only one house has been built close to the wetland in the north section and deer and raccoon use these tidal flats with frequency.

Bass Cove opens off the Kennebunk River at the right angle bend at the Arundel Golf Club. The Cove has two "arms", one heading northwest and ending on the golf course, the other heading southeast and narrowing down into a tributary surrounded by goldenrod-filled tidal flats. This tributary eventually heads across North Street and winds a quarter mile through thick woods; it then enters a wetland and ends on the east side of the telephone line clearing. Again, this is another quite wild area that is presently undeveloped and shows evidence of deer and raccoon.

Three small (3-6 feet wide) tributaries flow from

Kennebunkport into Goff Mill Brook near the northwest border of the town. This country consists of granite outcrops, upland hills, and lowland bogs and swamps, and these tributaries feed from the wetland areas in this varied terrain. This country is largely untouched; while not rich in wildlife diversity it is scenically beautiful. Where the soil cover is thinner, extensive young stands of poplar and birch surround open areas of granite ledge, bracken and leatherleaf, and pockets of sphagnum moss fill numerous small, wet areas. Larger wetland areas are rapidly becoming mature red maple swamps. Where more organic matter has accumulated, the forest is richer and supports white pines and red oaks. As organic matter accumulates, this area will continue to recover from the previous town-wide fire and become gradually richer and more diverse.

MILLS AND SHIPYARDS - HISTORY ON THE KENNEBUNK RIVER

Local historian Tom Bradbury notes that Arundel, Kennebunk, and Kennebunkport have gone through four periods of history: the colonial settlement in the sixteenth and seventeenth centuries; the shipbuilding era from 1766 to 1867; the era of the summer tourist economy that played a particularly prominant role around the turn of the century; and the present role of the towns as bedroom and retirement communities.

Much of this past history is centered around the Kennebunk River. This part of the Kennebunk River Study is concerned primarily with the historical artifacts found in the River itself from the colonial and shipbuilding periods.

In the colonial period (mid-1600's to mid-1700's) a variety of gristmills and sawmills were built along the River to take advantage of the continuous downstream waterflow or of the change in tides (see HISTORICAL MAP). Standing mills still exist at the entrance to Grist Mill Pond (Mast Cove) in Kennebunkport (originally the Perkins Grist Mill from 1751 to 1939; now the Olde Grist Mill Restaurant), and at Days Mills at the Arundel border.

Remains of mill foundations can still be seen prominantly at several locations. At Goff Mill Brook, the rock foundations of the original Goff Mill can be seen 1000 feet upstream of the Kennebunk River. The old fitted rock foundation extends out from both sides of the Brook, and three grist wheels can be seen among fallen rocks on the bottom at low tide. Gristmill foundations can also be seen of the Stephen Perkins Mill at Bass Cove, the Downing Mill on Goff Mill Brook above Sinnott Road, and at the Bartlett Mill site south of the Route 1 bridge next to the rapids. A mill foundation also can be seen just south of the Kennebunk Powder Mill condominium development.

The Indian Planting Ground was a large, fertile peice of land enclosed by a bend of the River at the Head of Tide on the Arundel side (see HISTORICAL MAP). This site had the advantage of having fresh irrigation water available above it and tidal access to the ocean below it. Fish were collected at both the coast and at local alewife and shad fish weirs in order to fertilize the cornfields (Ruth Landon, pers. comm.).

Shipbuilding became a major local industry before the Revolutionary War and 12 shipyards were concentrated along the floodplains of "The Kennebunk Landing" (11 on the Kennebunk side) in the general period from 1766 to 1830 (Murphey, Jr., 1977). Large pilings which are probably the remains of the old McCullough Wharf can be seen projecting out of the River banks just north of Durrells bridge (the smaller, vertical pilings south of the bridge are the remains of the old trolley line that crossed from River Road to Route 35; Joyce Butler, pers. comm.).

As the demand for larger ships increased, new shipyards replaced many of the older ones and 8 shipyards, many in new locations, are recorded on the Kennebunk side for the period 1831-1867 (Murphey, Jr.,1977).

In order to guide these large ships down the River at more frequent intervals than the biannual spring tides, the River Locks were built just below the present Arundel Golf Course in 1848. The locks allowed the upper River to be flooded at higher levels. Some ships, even though buoyed up above the normal water level, still passed within inches of the locks on each side. Once safely through, the boats were rigged with masts and sails at John Maling's rigging loft at the site of the present Arundel Yacht Club (Butler, 1983; Joyce Butler, pers. comm.).

At the beginning of the civil war "the need for larger ships than the river could accommodate, the beginnings of steel shipbuilding, and the introduction of wire rope delivered the 'coup-de-grace' to this industry". The last large shipyard on the River, the Clark Shipyard, was located next to the South Congregational Church just above the Route 9 bridge in Kennebunkport. This was considerably downriver of the more narrow Kennebunk Landing area. Over 100 ships were built here from 1883-1900. The remains of what appears to be the old shipyard slip can still be clearly seen here at low tide.

In 1918, the last ship, a small four-masted schooner named the Kennebunk, was launched from the Emmons-Littlefield/Charles Ward shipyards at the present Doanes Wharf location on the Lower River. This marked the end of large vessel construction on the Kennebunk River (Butler, 1983).

Ships that entered the River to pick up supplies unloaded their ballast into hollow pier cribs. The ballast consisted largely of flint, chert, and some coral, reflecting the trade routes to Europe and the West Indies. Remains of the original cribbing can still be found at the mouth of the River (Dave Bernstein, U. New England, pers. comm.).

COMMERCIAL AND RECREATIONAL USES ON THE RIVER

Uses from the Lower River to the Head of Tide

The greatest commercial and recreational use takes place on the Lower River. There are 7 commercial marinas with a total of 230-240 berths, two private clubs with 79-89 berths, and 4 other private docking areas with 13-15 berths. Fifteen lobstermen, 2 fishermen, and 25 sailboats also use public moorings in the lower River channel. Jamie Houtz of the Arundal Boatyard estimated that at least 2000 recreational boats bringing approximately 5000 people came into the Lower River during the past season; Chick's Marina alone registered 680 transient boats (those taking temporary berths) during the summer of 1986.

On 9/30/86, when rough sea conditions kept most boats in port, a total of 361 boats were counted on the Lower River (omitting skiffs and canoes). These included:

1. 186 motor boats (52%);
2. 136 sailboats (38%);
3. 9 commercial boats (2%);
4. 12 fishing boats (3%);
5. 18 lobster boats (5%).

Ninety percent of the boats present that day were recreational boats, and 10% commercial boats. Of the recreational boats, 58% were motorboats and 42% sailboats.

Reid's Boatyard is closing at the end of the summer and will be developed, but the Arundel Boatyard remains active. Goverment Wharf near the mouth of the River provides a place for lobstermen to pick up bait and other supplies and for fin fishermen to unload their catch. The Kennebunkport Marina maintains a boat ramp which is presently the only place of public boat access.

Eight commercial cruise/deep sea fishing boats use the River. There are two whale watching boats that take a maximum of 170 people; 4 deep sea fishing boats carrying 122 people; one sailing boat taking 6 people, 4 times/day; and a cruise boat carrying a maximum of 49 people, 4 times/day. All these boats go out every day in the spring and summer that weather permits and.many are active full-time until October 15.

Tourist accomodations, restaurants, and shops are also concentrated on the Lower River. There are 5 hotels or motor inns directly bordering the Lower River with a total of 139 units, 5 restaurants with a total of 643-743 seats, and 2 cafes with a total of 66 seats. There are 42 shops and galleries directly adjoining the River (with more than double that number in the immediate vicinity), as well as a yacht brokerage, a real estate business, and one educational enterprise, the Kennebunkport Maritime Museum (a complete list of all the commercial, private, and public enterprises on the Lower River is categorized in APPENDIX B).

Summer visiters use Gooch Beach on the Kennebunk side and the Breakwater Beach on the Kennebunkport side for swimming and sunbathing. The Kennebunkport jetty is a popular place to fish for flounder. The Monastery owned by the Franciscan Society of Brothers on the Kennebunk side is open to the public and provides a peaceful walkway along the River's edge as well as a view to the Lower River.

Above the Route 9 bridge there are more commercial enterprises clustered around the south end of the Kennebunk River Basin. Businesses which immediately adjoin the Basin in Kennebunk include 10 shops and galleries, a 28-36 seat restaurant, and one dental service. On the Port side, one shop and one 70-seat restaurant lie on the Basin.

During the high tides the River north of the Route 9 bridge is used by a variety of craft. Sunfish and sailfish occasionally use the Kennebunk River Basin, and the River is also used to the Head of Tide by motorboats, rowboats, canoeists, and kayakers. The stretch of water from the Basin north to Arundel Swamp Brook is used by waterskiers. Jet skiis are ridden downriver to the ocean from a few sites. Swimming is done cautiously by local residents due to both the effects of tidal currents and to speeding motorboats (the latter problem will be addressed in one of the ordinances at the end of this report).

Fishing, Hunting, and Trapping

Fishing, hunting and trapping are popular local sports, as evidenced by the numbers of resident liscences sold:

HUNTING, FISHING, AND COMBINATION LISCENCES
SOLD IN EACH TOWN

	Hunting	Fishing	Combination	Total
ARUNDEL, 6/85-5/86	253	135	116	504
K'BKPT, 1985	220	128	103	451
K'BUNK, 1985	474	412	218	1104
TOTAL:	947	675	437	2059

Approximately 14% of the 3 towns' residents therefore purchase liscences, much of it for local hunting. According to the Cumulative Impact Study "60% of resident hunting effort is carried out in areas of southern and coastal Maine...close to population centers...accessible for day trips and hunting before and after work" (Scudder, 1986). Local residents therefore rely on the preservation of diverse wildlife habitat for their hunting enjoyment. Hunting is popular among new residents as well, 26% considering it a high priority for the quality of life they are seeking in Maine (Scudder, 1986).

There is still enough wild land to support good deer, raccoon, and fox populations, although other animals, such as beaver, have been trapped out of the Kennebunk River system in Arundel and Kennebunk. As can be seen on the WILDLIFE MAPS, areas of high wildlife diversity are being reduced as development gradually encroaches on the larger blocks of wild land (see Wildlife Diversity and Development: an Inverse Correlation).

The main trunk of the Kennebunk River is rated as high fisheries value, and Goff Mill Brook, Wards Brook, Duck Brook, and Alewife Pond as medium fisheries value (Jones, 1986). Sea run trout, alewives, and stripers all run up the Kennebunk, and one of the tributaries is particularly known for its trout fishing.

Fishing tends to be concentrated around easily accessable sites such as the River mouth jetties, Government Wharf, the route 1 bridge, the Perkins Road Bridge, Days Mills, and Alewife Pond. A few paths into the tributaries encourage fishing at these sites as well.

Public Access to the Kennebunk River

Locating a public launch site for public assess to the Kennebunk River has been a strong concern of the towns. Presently, the Kennebunkport Marina does have a ramp on the Lower River which is available for public use at a nominal fee. A grassy floodplain site just below Durrells Bridge which is privately owned used to be open to the public for canoes and other small boats; recent abuse of the site caused it to be closed by the owners.

The three-town River Commission also researched the River for launch sites but could find no likely new locations. There are many reasons for this. The Lower River is already commercially crowded and has no available sites presently for a public launch. Even if such a site existed, it would be limiting for small boats such as canoes and rowboats because of the heavy traffic on this stretch of the River. Along the shores of the Kennebunk River Basin above the Route 9 bridge, shallow mud flats extend out for a considerable distance making it a poor place for boat access except at the highest tides. Other parts of the River have relatively high, steep banks which are vulnerable to overuse. Much of the River is also privately owned, which further limits possible site locations. Finally, the location of a launch site upriver is limited by the shallow waters beyond the Head of Tide.

CLASSIFICATION AND TESTING RESULTS ON THE RIVER

Classifying the River - What Does It Mean?

The classification of the Kennebunk River has changed three times in the last decade, from Class C to Class B2 to Class B. This would indicate that the quality of the River has been steadily improving. However, these Maine Department of Environmental Protection classifications don't refer to the actual quality of the River, but instead to an upgrading of the attainment standards that the Department hopes to achieve. The only way to know if the River is actually attaining Class B quality standards is to periodically test different sections of the River System.

The attainment standards legally mean the Maine D.E.P. would not allow any discharge from any polluting source under its jurisdiction to lower the legislated standards of the River.

What Qualities Make a Class B River?

A Class B river is one that supports somewhat lower oxygen levels and somewhat higher bacterial levels than a completely healthy, natural river (Class AA). Class B attainment standards mean that much of, but not all, of the species of aquatic life found in a completely natural river would be supported by these standards.

The attainment standards for a Class B River are described in terms of two tests - the percent of oxygen saturation (the D/O) that occurs in the water compared with a completely healthy waterway, and the number of warm-blooded animal intestinal (fecal) bacteria that can be counted in each millileter of water. The numbers of the latter vary according to whether a certain specific bacteria, *E. coli*, is counted, or whether all the fecal bacteria in this group (the coliforms - the round-shaped bacteria) are counted (see further explanation below).

These are the standards for a Class B waterway:

	Percent of dissolved oxygen saturation	*E. coli* bacteria/ 100 ml.	Fecal coliform bacteria/ 100 ml.
Freshwater	75%	427	534
Saltwater	85%	54	68

The dissolved oxygen saturation (D/O) measures whether a river (or any other water body) is overburdened with organic nutrients such as nitrates or phosphates. As these nutrients become excessive, rapid plant growth occurs, and these plants take oxygen out of the water to support their growth. The lower the saturated oxygen in the water, the greater the nutrient load.

This is referred to as eutrophication. It is a common problem in lakes where water flushing is infrequent and fertilizer, detergent, etc. runoff occurs. As excess plants grow (usually fast-growing algae blooms) they crowd out normal aquatic plants and reduce oxygen levels for fish and other aquatic animals. The problem is further compounded when the algae die back each winter. The decaying mass is attacked by decomposing bacteria that require additional oxygen to break it down; this continues to reduce the oxygen supply.

This demand by decomposing bacteria and other organisms is called the Biological Oxygen Demand (BOD). As the BOD increases, the dissolved oxygen (D/O) decreases. The D/O therefore indicates the effect the nutrient load is having on the River system.

The E. coli and fecal coliform tests indicate the level of human disease organisms present. The results of a recent E.P.A. study show that ear infections, hepatitis, and salmonellosis are not swimmer diseases as was previously thought. Instead, "the illness of concern for swimmer health is gastroenteritis: a relatively mild, short-term disorder characterized by vomiting, diarrhea, nausea, and/or stomachache" (McGovern, 1986).

The latter illness is caused by an intestinal virus, and these viruses are too small to be counted using current technology. There is, however, a high correlation between the numbers of E. coli bacteria (which are relatively large and can be counted) in the water and the number of viruses present. If the numbers of E. coli are low, the chance of being infected with this intestinal virus is also low (McGovern, 1986).

Since bacterial tests to date have been measured in terms of fecal coliform generally, and not E. coli specifically, the D.E.P. has made an approximate correlation between the two (see figures above).

Results of testing show the Kennebunk River System usually meets the Class B standards and also performs well in all other tests except nitrogen load (see further explanation below). Here is a summary of tests related to attainment standards (details of all the tests are given in Appendix C):

Maine Department of Environmental Protection Tests,
Route 9 to Days Mills, 8/5/80 - 9/26/83

	Number of tests above standards	Number of tests below standards
Dissolved oxygen	51	3
Fecal coliform	50	15

Friends of the Kennebunk River Tests,
Route 9 to Route 1, 6/22/85 - 9/19/86

	Above standards	Below standards
Dissolved oxygen	51	0
Fecal coliform	5	4

High coliform levels can occur in the summer and fall months when warm water conditions cause fecal bacteria to proliferate. The high coliform counts recorded here occurred periodically from June to October, with the greatest number of high counts in August. Cow manure is probably having the most significant impact on these coliform levels, although malfunctioning, old, or poorly maintained sewage systems and overboard discharge systems may also contribute to the bacterial level.

The water pH (the degree of acidity or alkalinity) measured within a healthy range of 6.0 - 8.0 on all tests. A measurement of 7.0 is neutral, 6.0 slightly acid, and 8.0 slightly alkaline. In New England, acid rain can increase water acidity to a point where fish and invertebrate life is stunted or killed. The local groundwater which gradually seeps into the River System probably provides the major buffering protection against acid rain (see Wetland Functions, Groundwater Discharge).

Nitrogen levels were measured by the Friends of the Kennebunk River from 6/22/85 - 9/19/86 (the results are listed on the last page of APPENDIX C under "ammonia"). Nitrogen levels were "quite high" but not toxic (David Courtmarche, D.E.P., pers. comm.).

Nitrogen levels ranged from 0.20-3.40 milligrams/liter and were almost always highest at the Route 1 Bridge. This almost certainly reflects the extra fertilizer load from dairy farms upriver (several large farms show intensive use by cows in the River System as well as trampling and loss of vegetation along the banks). The D.E.P. plans to test the nitrogen load further during the summer months in 1987 (the time when the greatest nitrogen is released). If levels continue to be elevated they will advise the Soil Conservation Service to work directly with dairy farm owners. Management options include fencing the cows away from the River System and replanting the river edge.

The D/O levels are usually always above attainment standards in spite of this high nitrogen load. This is probably due to the oxygenation of the River as it travels down over riffles and rapids before reaching the testing sites. Testing closer to the dairy farms however would undoubtedly reveal depressed D/O levels.

In order to cross-check their tests with a professional laboratory, the Friends of the Kennebunk River submitted one set of water samples to Peck Environmental Laboratories in 9/86. The results from the Laboratory closely matched those taken by the FKR throughout the year.

GROUNDWATER AND AQUIFERS

What Exactly is Groundwater?

Groundwater is simply rainwater or snowmelt which has percolated down through surface soils and unconsolidated subsurface material until it can go no further. When it reaches impermeable bedrock, the water collects.

Groundwater occurs wherever soils and surficial materials occur (virtually everywhere underground in the three towns). Under the pressure of constantly accumulating new rainwater the groundwater slowly percolates in a direction where it can be released, such as a river system.

What is the Relationship between Groundwater, Subsurface Deposits, and Aquifers?

The unconsolidated materials found over bedrock are known as surficial deposits. These materials range from fine clays to silts to sands to gravel. Groundwater moves through the open spaces between these particles.

Clay particles are very fine and therefore only small spaces are found between each grain. On the other hand, gravel is quite coarse and has much larger spaces between each stone. A much greater volume of groundwater can therefore be held between the coarse particles than can between the fine. Groundwater can also travel much more freely through coarse deposits because there is considerably less frictional (surface) drag against the larger particles.

The term permeability describes the capacity of a surficial deposit to transmit a fluid. Permeability is expressed in the number of gallons that can move through a cubic foot of surficial material in a day. Some typical rates are (Walton in Caswell, 1978):

Clays and silts.......0.001 - 2 gallons/day/ft2;

Sand.................10 - 3000 gpd/ft2;

Gravel............1,000 - 15,000 gpd/ft2.

Sand and gravel deposits, therefore, hold relatively large amounts of groundwater, and the groundwater moves through these deposits much more readily than it can in fine materials. These deposits are excellent for wells and local water supplies and are known as aquifers.

Aquifer Locations in the Three Towns

The sand and gravel aquifers in York County were formed primarily by glacial meltwater streams (Caswell, 1979), and consist mainly of well-sorted sands and gravels that draw 10 to 50 gallons/minute (Caswell, 1978). Aquifers are minimal in Kennebunkport where apparently little glacial outwash occurred, are found in approximately 10% of Arundel, and underlie almost 50% of Kennebunk (see AQUIFER MAP). Branch Brook is surrounded by aquifers and receives recharge from them; this supplys the main source of water for the Kennebunk, Kennebunkport, and Wells Water District.

How Groundwater Vulnerability has been Quantified for each Town

Because groundwater supplies exist everywhere that soils and surficial deposits are found (virtually everywhere in the three towns), and because it eventually flows out into river systems, groundwater protection is a concern at every location. Where is it safe to locate dumpsites, underground storage tanks, or certain industries? Recognizing this problem, the Maine Geological Survey has just completed maps for all of York County which quanitatively indicate the vulnerability of every area to groundwater contamination. This new system is known as the DRASTIC INDEX; each area is assigned a numerical value depending on 9 factors related to groundwater permeability and conductivity (see DRASTIC MAPS overlain on topographic maps for the 3 towns; Aller et al., 1985).

The Geological Survey divided the assigned DRASTIC numbers into 3 categories (Craig Neal, pers. comm.):

0 - 110	Not sensitive to groundwater contamination;
111 - 150	Nor very well protected from groundwater contamination;
151 +	Highly vulnerable to groundwater contamination.

A quick look at all the town DRASTIC maps shows that almost all the land within the 3 towns is "highly vulnerable" (over aquifers), or is "not very well protected" from groundwater contamination (two sets of numbers appear in each quantified section on the map: the circled number is an identification number only; the uncircled number is the DRASTIC number of concern here). This local vulnerability will be addressed in the Groundwater Ordinance presented at the end of this report.

The Most Likely Local Sources of Contamination

The Maine Geological Survey and the Department of Environmental Protection has estimated that 10% of York County sand and gravel aquifers are contaminated by human activity. They estimate 50% of this contamination is due to oil and gas leaking from underground storage tanks, 35% from salt storage piles or coastal overpumping, and 15% from landfills, solid waste, and industrial contamination (Scudder, 1986).

Other primary contamination sources that commonly occur include waste leaking from septic systems, hazardous materials spills and leaks, and runoff from the application of fertilizers, pesticides, and road salt (Mass. Audobon Soc., 1984). The D.E.P. also noted that overboard discharge systems can essentially discharge raw sewage into a river unless the system is properly owner-maintained.

The overuse of nitrogenous fertilzer and concentrated animal wastes can cause nitrates, which are highly carcinogenic, to build up in groundwater supplies. Pesticides can also readily leach into groundwater under the permeable conditions prevelent in the three towns (Mass. Audobon Soc., 1985).

The Kennebunk Landfill off Kennebunk Beach Road is presently listed as a potential groundwater contamination site, as are the Kennebunk lagoons on the Wells side of Branch Brook (see AQUIFER MAP, Maine Geological Survey, 1985).

WETLANDS AND THEIR FUNCTIONS

What Exactly are Wetlands?

Prominant wetlands along the Kennebunk River System include open aquatic wetlands, wet meadows, saltmarshes, shrub marshes, and woodland swamps. All these wetlands share the following characteristics (Mitsch and Gosselink, 1986):

1. Vegetation adapted to wet conditions (hydrophytes);

2. Unique soils formed by saturated conditions (hydric soils; exceptions occur when a wetland is newly formed);

3. Shallow water over, at, or close to the substrate surface.

Some wetlands are easy to recognize, others share less obvious characteristics.

Open aquatic wetlands cover all shallow quiet waters less than 6.6' deep, the maximum depth that emergent plants can grow (Cowardin et al., 1979). Wild celery, water lilies, arrowheads, pickeralweed, and other emergent and floating plants are found here. These wetlands occur along the lake edges of Alewife Pond, along the deeper parts of Davis Pond, and among quiet coves and backwaters of the Kennebunk River from the Head of Tide northward.

Wet meadows occur in such places as the lowlands around Alewife Pond, in the shallow beaver floodways along Wards and Goff Mill Brook, and in the extensive wild marsh bordering the mid-section of Wards Brook. Here thick groups of cattails, woolgrass, canary grass, panic grasses, and carex sedges interspersed with sphagnum moss and wetland wildflowers grow in saturated or flooded soils.

Saltmarshes are open tidal floodplains that support the familier salt-tolerant cordgrasses, black grass, and rushes. Gooches Creek is surrounded by extensive, productive saltmarsh flats and serves a valuable purpose as a fish nursery and feeding area for a diversity of wading birds, shorebirds, and mammals along Maine's saltmarsh-poor rocky coast.

Shrub swamps are found among the fringes between rivers and woodland swamps, or bordering wet meadows. Alders dominate these swamps with their tall, spreading growth.

Arundel Swamp Brook traverses extensive woodland swamp. This woodland swamp consists of mature red maples and white pines whose roots arch over pools of water; the trees are interspersed by extensive sphagnum moss cover and stunted black spruce.

Identifying a Wetland

Wetlands are best identified by a combination of three factors:

1. Wetland (hydrophytic) vegetation;
2. Water-saturated (hydric) soils;
3. Local hydrology.

For example, both red maple and white pine are hydrophytes, well-adapted to saturated soil conditions. However, these two plants are facultative wetland plants - they can grow just as readily in upland conditions. How then, can they be used to delineate a wetland? Wetland scientists point out that one important criteria of wetlands is that they are characterized as much by their lack of flooding-intolerant plants as they are by the presence of hydrophytes (Mitsch and Gosselink, 1986). For example, black oaks, which are a strictly upland species, won't be found in a red maple-white pine swamp association.

The association of red maples and white pines then indicates it is probably a wetland. To prove it with certainty, however, it is also necessary to test for hydric soils or assess the local hydrology.

Hydric soils are defined as those soils which are poorly drained or very poorly drained (USDA and SCS, 1985a; SCS, 1986). They can be sampled in the field and identified visually by color; a pamphlet and a brief course on hydric soils will soon be available (see below; also see Appendix D for a listing of hydric soils and their geographic locations).

A normal upland soil is well-oxygenated and each soil grain is typically surrounded by a precipitate of iron oxide. The iron oxide gives an upland soil its typical brown color.

By contrast, a hydric soil has become saturated with water over time. The saturated condition prevents oxygen from entering the soil. These saturated, anaerobic (i.e., lacking oxygen) soils can be recognized by changes in color.

Soil bacteria are always at work in a soil breaking down and digesting organic debris, and they need oxygen to do this. When a soil is anaerobic the bacteria break down the iron oxide, liberating oxygen and converting the iron to a more soluble form. The soluble iron oxide becomes dissolved in the surrounding water, and over time gradually leaches out of the wetland. When this happens the soil loses its brown coloration and becomes grey. A hydric soil may appear entirely grey or have grey mottling throughout it; such a soil can be recognized by digging up a sample and visually examining it.

Hydric soils typically take 25-100 years to form. Therefore, hydric soils appear in many, but not all, wetlands. For example, a new wetland formed by beaver ponding will not have had time to form a hydric soil.

In that case, local hydrological conditions can be used to identify a wetland. Wetland hydrological conditions which can be readily assessed include a water table high enough to reach the roots of the local vegetation (a condition tolerated only by hydrophytic plants), surface ponding, and seasonal flooding.

Many wetland plants - sphagnum moss, salt-marsh grasses, skunk cabbage, cattails, alder, etc. - do only grow in wet conditions. They are called obligates and can with certainty be used to identify a wetland.

A list of common plants seen along the Kennebunk River System and their wetland or upland status is given in Appendix D. A complete catalog of all U.S. wetland plants and their status is listed in the 1986 Wetland Plant List, Northeast Region, of the USF&W National Wetlands Inventory (one copy will be given to each town with this report).

A new publication called Hydric Soils of New England by Ralph Tiner and Peter Veneman from the the Massachusetts Cooperative Extension Service will be available in December 1986. It can be ordered through the Massachusetts Cooperative Extension Service, Bulletin Center, U. Massachusetts/Amherst, Amherst, MA 01003.

A one week summer course on all aspects of hydric soils and their identification will also be taught by Dr. Peter Veneman through the Department of Plant and Soil Sciences, University of Massachusetts/Amherst, starting in 1987.

Wetland Functions

Wetlands provide many rich, varied environments, and contribute significantly to the scenic beauty and variety of the Maine countryside.

Wetlands also fulfill a number of very practical functions. In a survey of York County wetlands, Paul Adamus (1986) found that they serve four particularly important purposes in this region:

> Floodwater Retention. The headwaters of almost all the tributaries feeding the Kennebunk River system originate in wetlands. Wetlands also surround some sections of the River system, and floodplain wetlands are extensive around the meanders between the mouth of the River and the Head of Tide.
>
> During storm events or during the spring snowmelt, wetland ponds, ponding areas, and floodplains fill with water and then gradually release these waters into streams and rivers. Wetland soils, particularly organic soils, have a sponge-like capacity and help absorb excess water as well. The thick vegetation of wetlands and floodplains also helps slow flood runoff and thereby decreases flood erosion (Caduto, 1985; Adamus, 1986; Mitsch and Gosselink, 1986).
>
> The latter authors write: "Riverine wetlands are especially valuable in this regard. On the Charles River in Massachusetts, the floodplain wetlands were deemed so effective for flood control by the U.S. Army Corps of Engineers that they purchased them rather than build expensive control structures to protect Boston" (data for 1972; Mitsch and Gosselink, 1986). During a major flood the Army Corps of Engineers found that upstream floodwaters were stored in the wetland floodplains and released slowly over a four day period, while most of the floodwater in the lower urbanized section of the River raced through in several hours (Caduto, 1985).
>
> The Maine Department of Environmental Protection notes that saltmarshes also have "a tremendous ability to absorb excess water caused by storms and heavy tides. A ten acre marsh can absorb three million gallons of water in a one foot rise" (1983). Saltmarshes also cushion the effects of storm surges, further buffering upland and residential areas from ocean flooding.
>
> Groundwater Discharge. Groundwater levels are relatively high in southern Maine, often at the level of local wetlands. Groundwater therefore

commonly seeps into area wetlands. The groundwater provides a steady, year-round supply of water which is then released slowly from wetlands into river systems. This generates a much more even, year round, water flow. The groundwater supply is also "softer" than surface waters; it picks up buffering minerals from underground which chemically help neutralize the effects of acid rain. These buffered waters, then, are highly important in the maintainance of healthy aquatic life.

Nutrient Retention and Removal. Water quality is enhanced as it passes through wetlands. Excess nitrogen and phosphorus from such sources as poorly functioning septic systems, sewage plant effluent, agricultural fertilizers, and animal manure can be largely removed by wetlands. The nutrients are converted into gas by soil microbes, absorbed by organic litter, adsorbed (bound) to organic peat and clay particles in the sediment, and taken up by living plants. Heavy metals, microbes, and viruses are also filtered out. The thick growth of plants characteristic of wetlands also greatly slows floodwaters and causes organic debris and soil sediment to settle out (Caduto, 1985; Adamus, 1986; Mitsch and Gosselink, 1986).

Wildlife Diversity and Abundance. Wetlands serve two very important purposes for wildlife. They supply broken down organic matter to riverine animals and nutrients to downstream plants in the spring; and they provide nesting sites or feeding areas for a wide variety of wildlife.

Wetland scientist Michael Caduto (1985) writes "Indirectly wetland plants support much of the life in open water. Every year the plants of the marshes, swamps, and floodplains die and their remains are left strewn over the soil surface. Fungi, bacteria, and other soil microbes break down this material. The annual spring floodwaters carry detritus from floodplain wetlands into the main channels of rivers, where it feeds juvenile fish and aquatic insects. These organisms in turn become food for the larger, predaceous fishes...and mammals like the otter".

The wetlands themselves also support a high variety and concentration of wildlife. Wetlands have "been shown...to have more species and more individual animals/acre, particularly during the breeding season" (Adamus, 1986). This concentration can be supported because wetlands form a highly productive pyramid of food production. Caduto (1985) writes "Wetlands are among the most productive ecosystems in the world. A fresh marsh is as productive as a rain forest, producing around 4.4 pounds (2 kg) of biomass per square meter each year. Diatoms and other algae, detritus, and large plants provide the base of wetland food chains".

This plant material as well as microscopic animals are taken up by a variety of aquatic insects, shellfish, snails, crabs, shrimps, frogs, turtles, snakes, wildfowl, and small mammals, which in turn support wetland carnivores such as snapping turtles, marsh hawks, ospreys, herons, mink, otter, and foxes. Wetland plants also directly support mammals such as muskrats, beaver, deer, and moose.

Almost all the factors which produce healthy fisheries are generated by wetlands and their groundwater supply: the salt marsh nurseries, the spring supply of organic detritus and nutrients which supports the aquatic food chain, the protective vegetative cover of backwater wetlands and shallow ponds, and waters buffered from acid rain.

Quantifying Wetlands Values

Since 1972 a wide variety of wetland evaluation techniques have been developed (Lonard and Clairain Jr., 1985). In Maine, the State Planning Office has been using a method developed for the Federal Highway Administration by Augusta resident Paul Adamus. Adamus Associates used this method (the Adamus Methodology) to examine the functional value of all large (10+ acres) wetlands in York County for the York County Cumulative Impact Project in 1986.

Under this system, each wetland is assessed by examining it in the field and filling out a questionaire on the wetland's physical and biological characteristics. Some typical characteristics which are assessed include vegetation density, percent of open water, type of water flow, the extent of annual flooding, and human disturbance (Adamus, 1983).

More specialized information on a wetland can only be gained from long-term measurements. If these are available, they are also included in the assessment. Some important long term measurements include plant productivity, average invertebrate density, dissolved oxygen content during annual stress periods (late winter and late summer), eutrophic conditions (i.e. excess nutrient loads), and the warmest summer bottom temperatures (Adamus, 1983).

This information is then combined and analyzed to give HIGH, MEDIUM, or LOW values to 18 different wetland functions. These functions include the following:

PHYSICAL FUNCTIONS:

Sediment and toxicant retention - effectiveness*
" " " " - opportunity**
Nutrient retention - effectiveness
" " - opportunity
Floodflow alteration - effectiveness
" " - opportunity
Groundwater discharge
Groundwater recharge
Exported productivity
Uniqueness
Shoreline anchoring
Sensitivity to Indirect Impacts

BIOLOGICAL FUNCTIONS:

Aquatic life
General wildlife breeding value
Fall migratory value
Beaver site potential
Potential black duck breeding value
Potential use by white-tailed deer

*Effectiveness refers to the probability that a wetland can maximize a particular function.

**Opportunity refers to the chance a wetland has to fulfill a particular function. For example, a particular wetland might have excellent flood retention capabilities but rarely receive significant floodwaters; it therefore would have a HIGH effectiveness rating but a LOW opportunity rating (Adamus, 1983).

Adamus does not recommend trying to combine the 18 different HIGH, MEDIUM, and LOW values. If a wetland rates HIGH for some values it often automatically rates LOW for others because the two sets of values are mutually exclusive. For example, flood retention could measure HIGH along a tidal floodplain wetland on the lower Kennebunk River but the fast moving tidal surge would make poor nesting habitat for waterfowl. Instead, Adamus recommends examining the importance of each wetland in terms of the total of each of its individual values (Adamus, 1985).

These 18 values help describe individual wetlands and the types of functions which might be sensitive to a variety of development impacts. These impacts could exist some distance from the wetland. For example, paving an area upstream of a wetland for a shopping mall would increase flooding and toxic runoff, and any residential developments within an average of 0.4 miles of a high diversity wildlife wetland would soon decrease that diversity (see Wildlife Diversity and Development: an Inverse Correlation).

In cases where a wetland has a number of valuable functions which may be heavily impacted by some future change, longer term tests (see above) will yield useful extra information. Adamus emphasizes that the one-day field method alone cannot describe some values, such as the highest annual groundwater level, or details of the aquatic plant and animal productivity. These functions have to be measured over their peak periods in order to gain the additional wetland information needed for making accurate planning decisions.

FLOODPLAINS

Recognizing Floodplains

Floodplains are the low, usually flat areas surrounding a waterway that are periodically flooded by the spring melt, by storm events, and/or by daily tides. Floodplains are actually formed and shaped by the waterway itself as it carves a contantly changing path through the landscape. Heavier floodwaters shape and flatten the existing floodplain through scouring action, while quieter floodwaters deposit soil and organic materials. Floodplains are therefore constantly exposed to a dynamic balance between erosion and deposition.

The broad saltmarsh floodplains south of the Monastery, and the saltmarsh floodplains of the old Kennebunk Landing north of Durrells Bridge are easy to recognize. Woodland floodplains may be harder to identify. Woodland floodplains are also low and flat, but tend to be more irregular than tidal floodplains. They often show signs of scouring and washout, as well as dry flood channels where flood waters flowed between river meanders. The undergrowth may be sparse or lush depending on the periodic scouring action of water and/or ice.

The best way to identify a floodplain is to first measure its extent on the FEMA floodplain maps (see below), and then check these measurements in the field. Floodplain field signs include low-lying flat, or approximately flat areas next to a waterway, signs of scouring and flood channels, hydrophytic (water tolerant) vegetation, and floodplain or wetland hydric soils. A check of the floodplain area during a high monthly tide or storm event will indicate its normal annual flood capacity as well as the extent of flooding. The absolute boundaries for the 100 and 500 year flood zones should be updated by state and federal agencies (see discussion below) or private firms.

The Value of Floodplains

Floodplains are commonly many times wider than the waterway they surround, and therefore have a tremendous capacity to hold and gradually release storm and tidal waters. Even during the fall 1985 hurricane, a relatively minor storm with little rainfall, tidal water levels rose 9 feet above normal. If the storm had occurred during high tide major flooding would have occurred.

In such a case, storm waters would flood over all the saltmarshes and tidal flats as well as over many higher freshwater marshes. These flooded areas would hold the waters

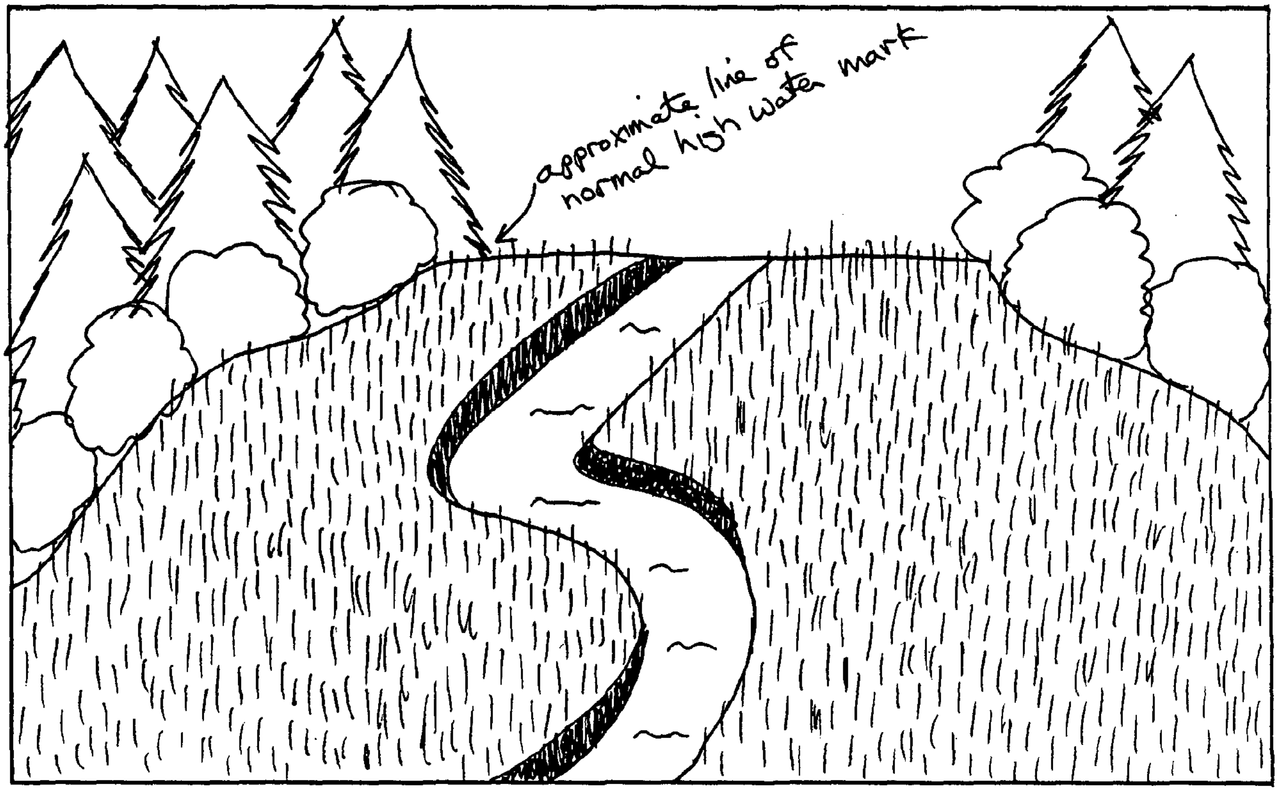

Fig. 2. A tidal floodplain. Tidal floodplains occur along the first 5 miles of the Kennebunk River, and can be recognized by their flat, open expanses of salt-marsh grasses (or freshwater grasses if far enough upriver). These floodplains are inundated during the higher monthly full and new moon tides and during ocean storms. The normal high water mark occurs where the grass floodplain changes to upland vegetation.

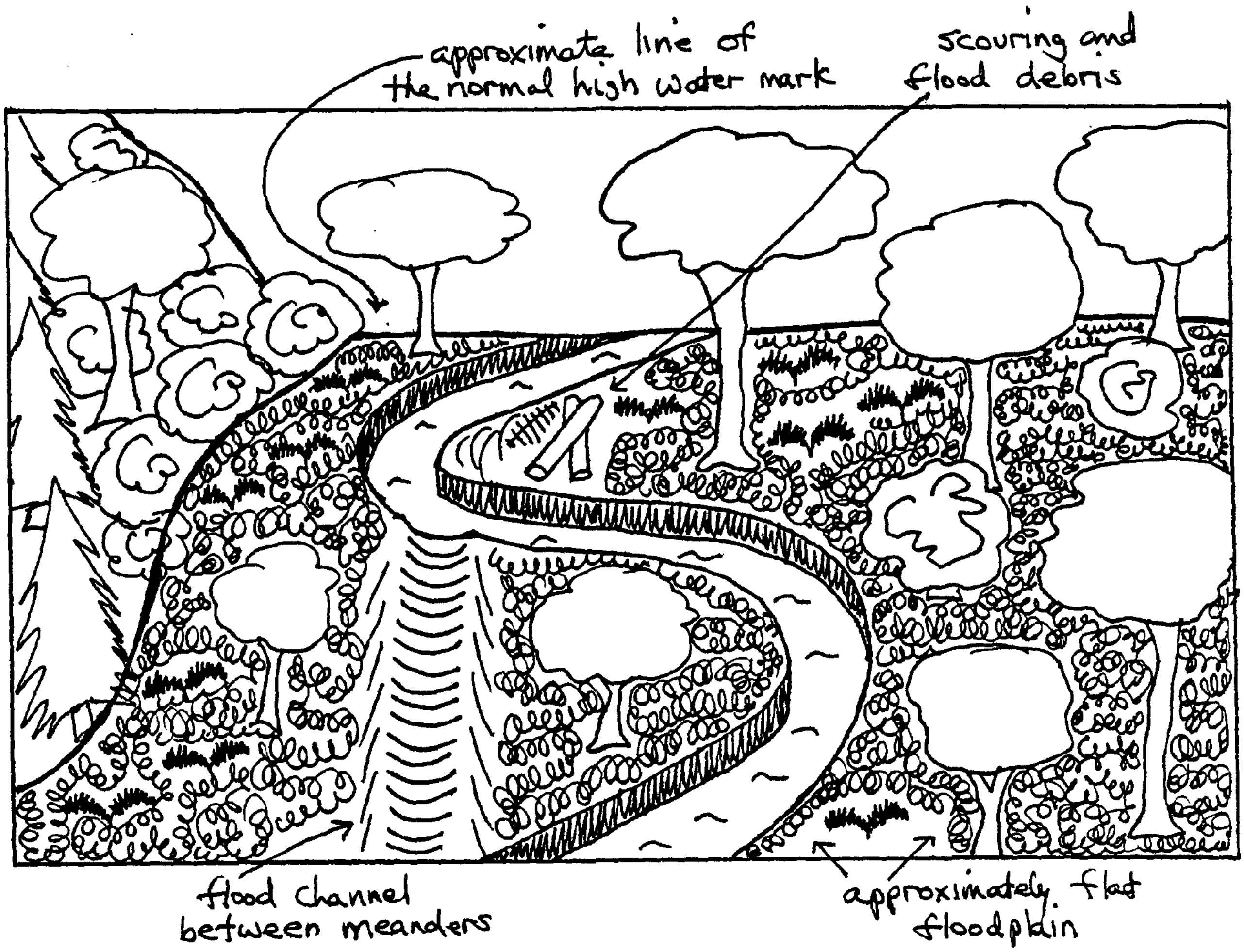

Fig. 3. Woodland floodplains occur in freshwater conditions. Even small (3-5 feet wide) tributaries can have floodplains extending up to several hundred feet or more beyond the immediate river channel. Woodland floodplains are subject to flooding during the spring thaw, after heavy or continuous rainfall, or after heavy storms.

These conditions can produce rapidly moving floodwaters which carve out secondary flood channels between the meanders of a river. The heavy flood conditions can also scour inside banks, leaving flattened plants and tossed-up tree trunks near the edge. The floodplain can be identified by these hydrological marks, as well as by its flat expanse and flood tolerant (wetland) vegetation.

A woodland floodplain in this area is commonly covered with red maple, white pine, and black spruce; with wetland shrubs such as elderberry, buckthorn, and arrowwood; and with a groundcover of wetland ferns and grasses. Heavy annual flooding may leave some floodplains with little understory.

for gradual release. Salt marsh flats in particular have spongy organic soils which have an excellent capacity to absorb some of the flood water. Their thick vegetative growth also helps slow the release of flood water. A landmark study of the tremendous economic and retentive advantages of floodplains on the Charles River in Massachusetts was carried out by the Corps of Engineers in 1972, and is described in this report under Wetland Functions, Floodwater Retention.

How is a Floodplain Defined?

Because they are flooded periodically, floodplains usually only support water-tolerant plants (hydrophytes). Floodplain soils can also be hydric soils. This means that many floodplains are also wetlands. However, while such floodplains come under wetlands protection, floodplains overall are defined in different terms. The major concern in any floodplain definition is the extent of the total area which would be flooded in a major storm event. Floodplains are therefore defined in terms of their 100 year storm boundaries (the extent of flooding occurring during the largest storm in 100 years) and by their 500 year storm boundaries.

Floodplain maps have been produced for each town by FEMA (the Federal Emergency Management Administration). These delineate the boundaries of the 100 year and 500 year flood levels for all major waterways and tributaries. "Field methods" were used to assess the boundaries in Kennebunk and Kennebunkport, and "approximate methods" were used for Arundel (see set of FEMA floodplain maps given to each town with this report). Both methods use maps and aerial data to place approximate boundaries; however, this is checked in much more detail and more precisely in the field for the larger towns. More accurate information on specific site flood boundaries in Arundel can be obtained from state and local agencies or private engineers (see below).

Even the most precise field maps only describe the conditions at the time the maps were made, however. All water flow is part of a dynamic, changing process. Both external causes and the action of water itself can create changes in the landscape.

For example, natural river channels constantly change position as they undercut banks on the outside of a meander and deposit materials on the inside. As a river channel changes it creates changes in the shape of the floodplain as well.

Secondly, global weather patterns also change over time. Due to the greenhouse effect, steadily rising temperatures are causing a rapid rise in sea level. Over the next century, the average sea level is predicted to rise 1 to 5 feet along the Maine coast (Jane Arbuckle, pers. comm., Maine Audobon Society). This will have a major impact on flooding and flood boundaries in Kennebunk and Kennebunkport.

Finally, more local factors, such as the paving and culverting of increased amounts of the Kennebunk River watershed, will result in greater amounts of immediate water runoff after a storm event. This will increase both the immediate flood effects and the height of the flood plain boundaries.

Future development changes in the watershed, then, are likely to increase immediate flood runoff. Other factors, such as the rise in sea level, will also considerably raise flood levels for several miles inland (i.e., the Head of Tide occurs 6 miles upriver on the Kennebunk River). Flooding effects can be minimized by preserving existing wetlands and floodplains and by updating the 100 and 500 year flood boundaries for the most recent conditions.

Both the local federal office of FEMA and the state DEP work cooperatively to help town regulatory bodies delineate floodplain boundaries. They can be approached directly for help, and will also review the floodplain boundaries drawn up by private engineering firms for subdivision plans (state subdivision regulations require 100 and 500 year flood boundaries whenever one lot which includes a floodplain is being subdivided into three lots; FEMA requires the same for subdivisions that are at least 5 acres in size or 50 lots, whichever is smaller). The addresses for these offices are:

Flood Insurance Program
Coordinator
State Planning Office
State House Station #130
Augusta, ME 04333

Natural and Technological
Hazards Division
FEMA
Region 1
J-W-McCormack POCH
Boston, MA 02109

Both agencies should be contacted as they cooperate together on local floodplain assessment.

A new state model floodplain ordinance will be available from the State DEP by the end of 1986 (Fred Michaud, pers. comm., Maine DEP). Presentations on this ordinance will be made by the state shortly afterward. For that reason, a floodplain ordinance was not included as part of this report.

WILDLIFE DIVERSITY

Wildlife Diversity and Its Implications for Town Planning

The abundance of wildlife, and the rural environment that supports it, is important to local residents. Fourteen percent of the population of the 3 towns buy resident hunting and fishing liscences every year, many for local use. A survey of new residents shows that 70% place high priority on enjoyment of woods and natural areas, 74% considered enjoyment of the natural environment highly important, and 26% considered hunting a high priority in pursuing the quality of life they seek in Maine (Scudder, 1986; see COMMERCIAL AND RECREATIONAL USES ON THE RIVER).

In spite of this enjoyment and use of the wild environment by residents, preserving wildlife as a significant natural resource has not yet been sufficiently integrated into local town planning. In this study there was a direct correlation with the closeness of development and the loss of both the numbers and variety of wildlife (see Wildlife Diversity and Development: an Inverse Correlation).

Wildlife diversity can be preserved by protecting the shoreland buffer zones, creatively clustering residential and commercial development so blocks of wilder land are kept intact next to valuable wildlife areas, and by using easements, zoning, and other procedures to preserve larger peices of contiguous wildlife habitat. Each of these topics will be addressed below.

Documenting Wild Areas

The remote, wilder parts of the towns remain an unknown resource to most citizens. The beauty and wildness of these places isn't apparent until suddenly the land is opened up for development, and then it is difficult to make changes. However, these wild resources can be documented, and documented inexpensively, before radical land use changes take place. Advanced planning can then be carried out for the preservation of these resources.

In this study, documentation was carried out by walking all of the main trunk of the Kennebunk River and its tributaries. Evidence of scenic diversity, wildlife activities, botanical changes, and problems along the River System were recorded and photodocumented in detail. There is now a good collection of slides on all aspects of the River, including the remote and beautiful wild areas where few people have visited. The slides have served as a handy reference and educational resource for planning boards, selectmen, conservation commissions, and other public groups.

This process can be inexpensively carried out by a practiced biological observer who is familier with photographic equipment, and does not have to be done by a consulting firm. Other river systems and wildlife areas in the towns can be documented in the same manner, and wildlife diversity indices added onto the enlarged transparent mylar topographic maps that already exist from this study.

A New Method of Quantifying Wildlife Diversity

The best way to understand how animals are using an area is to directly check this use in the field. In many ways a riparian study is ideal for this. Not only do wild animals concentrate around water sources (see The Importance of a Shoreland Buffer Zone for Wildlife), but sand and clay river bottoms and the muddy edges of wetlands provide excellent places to observe animal tracks.

Animal trails can also be found along marshes and in the woods; and scats, dens, and other clues (peices of fur, the remains of a kill, chiseled poplar logs) provide further evidence of use by specific animals. Checking tracks in the winter after a snowfall will add evidence of animals whose prints are less readily seen in the warm months (i.e., fox, mink, and snowshoe hare).

Animals can also be seen directly. This has less significance for understanding mammalian use of an area, but is very important for documenting use by birds which don't indicate their presence by tracks or calls (i.e., marsh hawks, great horned owls, migrating shorebirds and warblers.)

Animal use recorded from the above evidence can be quantified readily for every 1/8 mile traveled and then assigned a general value of low, medium, medium-high, and high diversity (for the specific system used see Appendix E). These categories include the following species and concentrations:

High diversity	Presence of beaver ponds;
	Concentrated evidence of shorebirds, wading birds, grouse, wood duck, snowshoe hare, mink, muskrat, otter, skunks, porcupine, raccoon, woodchuck, fox, deer, and moose;
	Common evidence of woodcock, kingfishers, hawks, and passerines.

Medium-high diversity	Common evidence of shorebirds, wading birds, skunks, woodchuck, raccoon, fox, and deer; Occasional woodcock, grouse, wood duck, hawks, owls, woodchuck, mink, porcupine, otter, and moose.
Medium diversity	Common evidence of skunks, raccoon, and deer; Less common evidence of shorebirds, wading birds, woodchuck, or fox.
Low diversity	urban/suburban colonizers only; common evidence of starlings, house sparrows and pigeons; Occasional raccoons and skunks.

In assigning diversity values, the frequency of individual species seen is more important than the overall number of total species seen. Not all species in a category will be found in one location because many of the animals listed require differing habitats. Here are two varied examples of high diversity wildlife habitats along the Kennebunk River System:

Beaver Ponds Along an Arundel Tributary

A chain of ponds was dammed by beavers at this location approximately 4 years ago. The change in wildlife diversity from the surrounding land is immediately apparent. Kingbirds, migrating warblers, kinglets, and chickadees use the shrub edge, and groups of sparrows feed under panic grass patches in the marsh. A marsh hawk regularly patrols over the ponds, and kingfishers frequent the area. Evidence of muskrats is plentiful, and green and great blue herons feed at the water's edge.

Deer and raccoon tracks are not particularly common here because the surrounding area of stunted birch and poplar are not their preferred habitat. The commonness of the species who do use this as their natural habitat, however, indicates this falls within the high diversity category.

A Kennebunk Tributary

This 20′ wide tributary is thickly overgrown with a mixed early mature forest with a good understory. Sandy and clay bars along the Brook bottom are thick with deer and raccoon tracks, and these are intermixed at frequent intervals with those of mink, otter, and fox. Both moose tracks and scats were seen at several locations. In the winter, snowshoe hare, fox, and grouse tracks appear in concentrations in the snow. Porcupines were occasional. Patches of feeding snow buntings were seen in winter, and periodic groups of migratory warblers and their cohorts appeared near the marsh edges in the fall.

The heavy concentrations of at least 8 mammalian species definitely defines this area as high diversity.

The Extent of Wildlife Diversity in the Three Towns

The three towns have the following total milage of wildlife diversity along the Kennebunk River System:

	Low diversity/ mile	Medium diversity/ mile	Medium-high diversity/ mile	High diversity/ mile
ARUNDEL	0	16	14	2
K'BUNK	0.5	8	20	6
K'PORT	1	4	1	0

Wildlife Diversity and Development: an Inverse Correlation

The WILDLIFE MAPS outline the different categories of wildlife diversity along the Kennebunk River system in each town. Looking at these maps, it soon becomes apparent that the greatest wildlife diversity seems to occur at the greatest distance from residences. To check this, measurements were made at regular intervals from the River to the nearest residence and then averaged (see Appendix E for procedure and conclusions). Here are the results:

Wildlife diversity category	Average distance from Kennebunk River waterway to nearest residence
Low diversity	Less than .01 mile
Medium "	0.13 miles
Medium-high "	0.25 miles
High "	0.43 miles

There is clear correlation between the extent and variety of wildlife seen around the River system and the distance from the nearest residence. As residences encroach into the system from different directions, the wildlife diversity shrinks. This can be seen on the Arundel Wildlife Map, where development has occurred near many of the waterways, and areas of high diversity are small in size.

Animals need to feel safe and protected from potential predators. They may stay clear of residences because of sounds of talking, shouting, dogs barking, cars, motorcycles, or snowmobiles; because of unleashed dogs; because of human activity in their habitat; or because parts of a woodland have been harvested or pruned and therefore cleared of their protective cover.

Of all these effects, wild animals appear to be the most affected by human activity within their habitat. In this study, animal tracks became scarce or non-existant around areas where people had tramped out paths, cleared the understory between their residence and the River, or had camped, as evidenced by beer cans and partly-burnt logs. These activities were associated with nearby residential development and well-used 4WD roads.

The reverse effect also can take place near residences where human contact is minimized. Animals tracks were seen relatively close to partially abandoned farms with little residential activity, and appeared close to residences which were separated from the wild habitat by a natural barrier such as a cliff or wide waterway, or by a manmade barrier such as the Maine Turnpike.

To preserve the high diversity wildlife areas around the Kennebunk System waterways, then, it is important to keep these areas well-buffered from human activity. It is also important to provide connecting corridors between blocks of wilder land so animals can travel freely between them. Many New England mammals have very large home ranges, and these animals quickly abandon isolated patches of wild land (see Larger-scale Planning for Wildlife Diversity).

The Importance of a Shoreland Buffer Zone for Wildlife

The importance of wild river corridors for wildlife is well-supported by data from the Maine Department of Inland Fisheries and Wildlife and the Department of Wildlife, U. Maine/Orono, as well as from data collected in this study. River corridors provide the following advantages for wildlife:

1. Drinking water;

2. Water invertebrates and fish for food;

3. A rich source of plant foods fed by nutrient run-off from higher ground;

4. Dense cover provided by the diversity of plants that grow along any environmental edge;

5. A greater diversity of plants at different heights, providing a greater variety of nesting and denning sites;

6. Open travel corridors along the waterways themselves.

A report by the Maine Cooperative Wildlife Unit (Dibello, 1982) summarizes the extensive radiotelemetry and snowtracking data gatered on furbearers by the State of Maine. They found that coyotes, fisher, martin, red fox, and bobcats all strongly selected the first 100 M (330') of a river edge as part of their home range habitat. The animals also extensively used these river corridors as traveling routes.

A survey of deer yards in Maine found that 85% occurred in conifer stands along rivers. The lowland topography and dense vegetation of these areas sheltered the deer from low temperatures and high winds, and the waterways themselves provided travel routes that tended to have more shallow or more densely-packed snow cover than upland habitat (Banasiak, 1961).

Moose make extensive use of shallow pond edges and marshes for feeding in the summer (Marston and Donovon, 1984), and the author saw trails of fresh moose tracks near local waterways in October.

"Common aquatic furbearers such as muskrat, beaver, otter, mink, and raccoon are all dependent and closely associated with the riparian zone. Muskrats are primarily vegetarians and rarely are far from water. Beaver feed on the bark of poplar, maples, birches and most of all hardwood, and their feeding area is limited primarily to within 300' of water. Otter are primarily fish eaters, but crayfish and frogs are also important prey items. Mink are adopted for hunting on land and in water and important aquatic foods are fish, frogs, and crayfish. Mink stay close to the streams while hunting (less than 600') and den sites are usually less than 300 feet from streams. Raccoon dens are normally within 400' of streams...(Toweill and Taber; Linscumbe et al., and Stuewer in Marston and Donovon, 1984).

Non-game birds are found in higher densities in floodplain habitat than in upland woodland or open herbaceous habitat (Stauffer and Best, 1980). Pileated woodpeckers "are typically found nesting in riparian areas no greater than 330' from water (Conner et al. and Hoyt in Small and Johnson, 1984), and in interior Maine, bald eagles commonly nest in white pines within 330' of large water bodies (Todd in Small and Johnson, 1984).

Using this information, Small and Johnson (1984) from the Department of Wildlife, U. Maine/Orono, recommend the following protection for riparian (river) edges:

1. A preserved 250' zone of riparian buffer edge;
2. No harvesting in the first 80' of the riparian zone from the normal high water mark;
3. Selective harvesting only in the remaining buffer zone of 80-250'; (their quidelines for this are similar to the state regulations for shoreland harvesting);
4. The retention of hardwood snags (dying trees), as well as some dominant white pines.

The latter recommendation is based on the importance of dying trees for cavity-nesting birds associated with waterways (pileated woodpeckers, wood ducks, barred owls, tree swallows), the importance of large white pines as nesting sites for bald eagles and other raptors, and the use of both types of trees by ospreys.

The recommendations for harvesting controls are based on the needs of most wildlife for thick, forested protective cover, as well as the need for vertical diversity for nesting and denning habitats. Softwoods along riverways provide the primary cover for deer, and optimal deer yards occur in tall, closed canopy stands. Fisher prefer uncut softwood stands as habitat. Red foxes will utilize fields for prey but their tracks lead back to dens in the forest, and snowshoe hares and red squirrels prefer uncut softwoods and partially-cut stands (Sherburne and Matula and Monthey in Dibello, 1982). Bobcats venture only short distances from forest cover (May in Small and Johnson, 1984).

Small and Johnson write: "In winter, undisturbed riparian habitats are of great importance because a wary animal can move easily in the shallow snow on frozen waterways while remaining close to cover afforded by riparian vegetation".

Bird species richness also increases with the increasing width of riparian wooded habitats (Stauffer and Best, 1980). Wild ducks will only breed and raise their young along river banks if protected nesting sites exist nearby, and if overhanging shrubs and trees, as well as aquatic plants, provide easily accessable hiding places.

The shade provided by forested tree cover along a river edge maintains cooler water temperatures required by aquatic invertebrates and fish; the tree canopy also greatly reduces surface evaporation and helps maintain consistant year-round water flow (Davies and Sowles, 1984).

As noted above, animals avoided river properties where all protective lower tree cover and shrubs had been removed. Thus it is important to not only preserve the native woodland along river corridors, but the variety of small tree cover and underbrush as well. Wild animals are always on guard for predators; they avoid areas where they are exposed to potential dangers. Shrubs and small trees are also important food sources for berries, nuts, and bark, and provide a diversity of nesting sites.

Homeowners can increase the wildlife around their properties by preserving a larger buffer zone or other large areas of natural forest. Some birds such as the wood thrush, ovenbird, and towhee which are associated with deep woods will only nest in forested patches that are at least 500-650' in diameter (Stauffer and Best, 1980).

Larger-scale Planning for Wildlife Diversity

Saving the river corridors alone isn't enough. Most New England mammals need large home ranges (raccoons average a 2 mile circular home range, deer 2-3 square miles, foxes somewhat under 5 miles, otters 15 or more linear miles (Godin, 1977; Jones, 1986). These mammals need contiguous areas of unbuilt open space to meet their food and breeding requirements. A wild area can be preserved, but if it remains an "island" disconnected from other wild areas, these animals will desert it.

In this study it was seen that an average distance of .43 miles from the nearest residence was needed to protect the greatest diversity. These areas also were protected from easy human access; walking trails, 4WD roads, and other kinds of entry trails quickly lower diversity (this has happened at Alewife Pond).

An important aspect of wildlife protection, then, is maintaining good-sized contiguous, undisturbed wild areas next to the river corridors. Large wild areas can be preserved in several ways:

1. Cluster housing - units can be clustered near main roads and other nearby residences so wilder parts of a property remain protected. Ideally, the wild part of the property should adjoin other unbuilt areas or adjoin connecting wildlife corridors and river corridors so contiguous wild lands are joined for maximum wildlife preservation.

2. Conservation easements - individual property owners can legally protect part or all of their property into perpetuity through a conservation easement specifying how they wish that preservation to take place. An easement does not change the private status of the property; it may, in fact, qualify the property for a tax reduction. The easement can be placed with a public trust such as the Kennebunkport Conservation Trust. They have a program for annually checking the property and maintaining its ongoing protection. Tom Bradbury is the current president of the Trust and can be reached at 967-5673 for more information.

3. Zoning changes - if an area of high diversity is surrounded by large property holdings (which is usually the case) the owners may be agreeable to zoning their particular area for a considerably larger lot size. Some rural communities have chosen to rezone certain agricultural and forest areas into 20 or 25 acre zones; a larger zone of 50-200 acres would provide even better protection.

Preserving wildlife diversity not only saves the wild heritage within each town, it also saves much of the scenic and rural qualities associated with the value of living in Maine. The alternative is the spread of a homogeneous suburbia across the towns' present spectacular and varied open space.

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Some Additional Wildlife Considerations

Returning Beavers to the Area

Beavers have greatly enriched the wildlife diversity in the three towns, creating ponds in a region where natural ponds and lakes are infrequent. Local beaver ponds rapidly become populated with fish, turtles, and muskrats, and attract otter, deer, moose, marsh hawks, kingfishers, and wading birds. Recently beavers have been trapped out of all their recent sites along the Kennebunk River System in Arundel and Kennebunk. Some ponds are still intact, but others are rapidly draining away as the beaver dams break down.

Trapping is controlled by the Maine Department of Inland Fish and Wildlife, and Sandy Eldridge, at 1-800-322-1333 can be contacted about the need for town trapping restrictions. The IF&W is sometimes asked to remove beavers from farm sites and other locations and is more than willing to transfer these animals into any trapped-out sites or new sites with the permission of the property owner. The only requirement essential for the animals is a good stand of poplar near the site. Again, contact Sandy Eldridge at the above number for beaver transfers into the area.

Protecting Temporary Ponds

Vernal ponds are temporary wooded ponds that fill during the spring runoff and dry out in the summer. These ponds support breeding salamanders and other amphibians, and are valuable to these animals because of the lack of larvae-eating fish found in most standing ponds. All three towns have vernal ponds where yellow-spotted salamaders breed; populations of these animals are diminishing, however, due to loss of habitat.

The vernal ponds are usually formed in small (10-150' diameter) woodland hollows and can be defined as wetlands because of their hydric soils and hydrology. Wetland plants may be present or no plants may grow in these hollow at all. The ponds are readily recognized in the springtime but can be missed during the dry season.

Another kind of temporary pond worth preserving are the open, low muddy areas in fields that flood periodically. They provide a special feeding habitat rich in small invertebrates and plant seeds for shorebirds and ground feeding songbirds. This kind of habitat tends to be overlooked but is worth preserving as shorebird feeding habitat diminishes.

Both these kinds of habitat can be protected under a wetlands law; homeowners can also help maintain or reconstruct such habitats.

THE SUGGESTED THREE-TOWN COORDINATED ORDINANCES

(The full ordinances are listed on pp. 74-86.)

Introduction

These ordinances are presented to protect natural resources which are presently unprotected or poorly protected. They are the result of information gathered from field exploration of the Kennebunk River, and from discussions with state personnel, data from research reports and previous town studies, and information from local townspeople.

The Shoreland Zoning Amendments and the Wetlands Ordinance suggested here are updated versions of ordinances already commissioned previously by the Town of Kennebunk (Adamus and Kehoe, 1982; SMRPC, 1985). The Groundwater Protection Ordinance is taken directly from recommendations in a groundwater report also commissioned by Kennebunk (SEA Consultants, 1979).

Each ordinance is based on background material which is given in this report. For example, the section "Wetlands and Their Functions" describes local wetlands that are part of the Kennebunk River System, the functions they serve in this area, and the plants, soils, and water conditions which are used to identify a wetland.

Background for the Shoreland Zoning Amendments is discussed under "The Importance of a Shoreland Buffer Zone for Wildlife" issues of groundwater vulnerability under "Groundwater and Aquifers", and overboard discharge is reviewed below.

A short summary of the rationale for each ordinance is presented here.

Reasons for the Suggested Ordinances

The Shoreland Zoning Amendments

These amendments are proposed to protect both the scenicness and the wildness of our lakes and rivers by creating a natural, vegetated buffer zone between residential and commercial use and the shoreland's edge. This buffer or shoreland zone will preserve wildlife corridors, provide scenic protection for boating and viewing, and preserve fishing resources. This ordinance suggests a 75 foot buffer zone for denser areas (the Limited Development District), and a 330 foot buffer zone for lower density areas (the Resource Protection District).

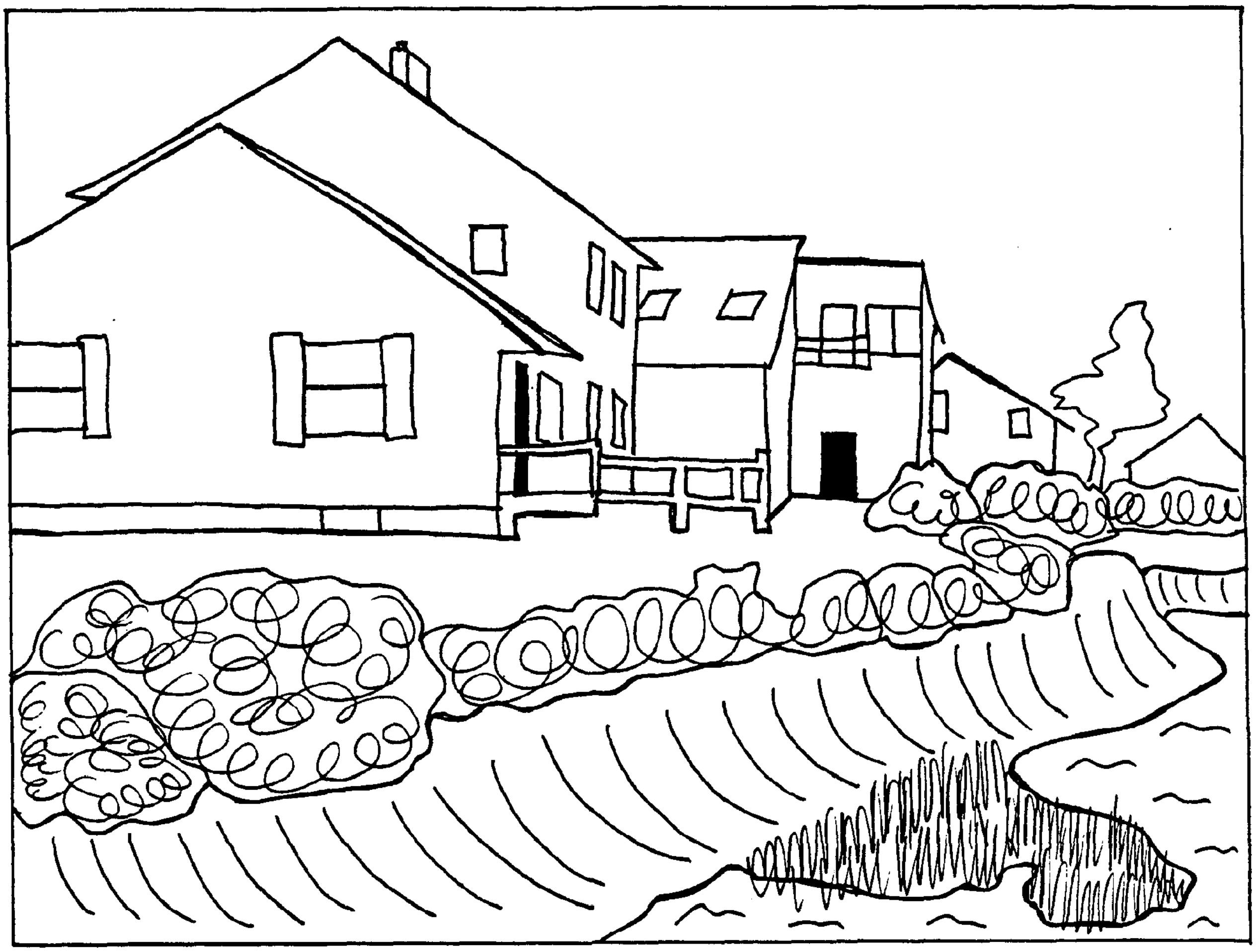

Fig. 4. Housing on Gooches Creek off Beach Road in Kennebunk. These houses are placed at the present 75 foot setback. This setback provides little scenic protection for the riverway and eliminates the shoreland buffer zone for wildlife.

The 330 foot zone of the Resource Protection District is a minimal critical buffer based on data and recommendations from the Department of Wildlife, University of Maine/Orono, and the Maine Department of Inland Fisheries and Wildlife. They recommend a 330 foot natural setback for the protection of wildlife (see details under "The Importance of a Shoreland Buffer Zone for Wildlife" under WILDLIFE DIVERSITY); this ordinance therefore suggests the same building setback with an 80 foot cut into the buffer zone allowed for construction and placement of a lawn and landscaping around a building.

The present 75 foot state minimal setback places housing virtually right on the waterways and eliminates any wild, critical edge (see Fig. 4). The 250 foot zone to the boundary of a yard would provide this minimal critical wildlife corridor. At present, the Saco Coalition is asking for a similar building setback for the Goosefair Brook Resource Protection Zone in Saco; they will then promote its extension to the rest of the town. The York Conservation Commission is also presently preparing an ordinance similar to ours to cover the Resource Protection Zone in the town of York.

The Wetlands Ordinance

The Kennebunk River and its tributaries, as well as other river systems, are supplied by 2 important storage resources - wetlands, and groundwater. Thus the health of all rivers and lakes depends on the health and preservation of these water resources.

A wetlands study carried out by Adamus Associates in 1986 showed that York County wetlands serve four important functions:

1. Flood control;

2. Holding and gradually releasing groundwater, creating a year-round even flow into lakes and rivers;

3. Releasing a spring nutrient supply to support the aquatic food chain, and holding pollutants and excess summer nutrients;

4. Supplying necessary wildlife habitat for shellfish, invertebrates, fish, waterfowl, migratory birds, and game animals.

The wetlands ordinance is based largely on work done for the town of Kennebunk in 1982 by Adamus Associates. It protects all wetlands in the three towns and provides for a graded buffer zone around them, depending on the size of the wetland. By comparison, the new state wetlands ordinance protects only a small minority of local wetlands.

The U. S. Environmental Protection Agency is currently urging all York County towns to take measures to preserve wetlands.

The Groundwater Protection Ordinance

Much of the water from rain or snow percolates through the earth to the water table (groundwater supply), then gradually seeps out into river systems. The health of local rivers and lakes therefore also depends on the health of local groundwater. The water from Branch Brook is used directly as a district water supply, and groundwater generally supplies numerous home wells throughout all 3 towns.

The vast majority of soils in the three towns are easily permeable, meaning they are "not very well protected" or are "highly vulnerable" to groundwater contamination from human sources (see "How Groundwater Vulnerability has been Quantified for each Town" under GROUNDWATER AND AQUIFERS). SEA Consultants did a study for the town of Kennebunk in 1983 recommending additional land protection over aquifers; their three recommendations are incorporated into the suggested ordinance presented here.

An Ordinance Eliminating Overboard Discharge Systems

Even properly maintained overboard discharge systems release some nitrogen and carbon products into waterways; they also release the chlorine used to disinfect intestinal bacteria. The nitrogen and carbon products add to the water's nutrient load and lower dissolved oxygen levels, while the chlorine continues to affect other living organisms.

Chlorine is a toxin that can kill all forms of aquatic life in sufficient doses. Overboard discharge systems have been banned in several towns because of the damage chlorine causes to clam flats.

Therefore, the greater the overboard discharge in an area, the greater the nutrient and toxic chlorine load.

If an overboard discharge system is poorly maintained, then raw, untreated sewage is also released into the waterways. While the systems are supposed to be regularly monitored by the Maine D.E.P., in reality this doesn't happen. New systems were checked by the D.E.P. in the three towns this summer; this was the only time their personnel have appeared in the area in the last 9 years. The D.E.P. noted that usually their summer interns are needed for other work.

In order for an overboard discharge system to work properly the homeowner is responsible for periodically removing the sewage sludge and renewing the chlorinated tablets. Even well-meaning homeowners admit that they don't maintain their systems regularly, particularly when the summer season gets busy.

As development pressures continue along the River, there will continue to be applications for more overboard discharge permits as units are built on land inappropriate for septic systems. This will lead to the increased liklihood of uncontrolled sewage discharge, as well as the steady increase in nutrients and toxic chlorine. Overboard discharge permits have been banned completely by the towns of Phippsburg, Brunswick, and West Bath. The Phippsburg ordinance is included in its entirety in the ordinance package.

Extension of the 5 M.P.H. Speed Limit to All of the Kennebunk River

A 5 m.p.h. speed limit presently exists on the Lower River only. Residents have complained about speeding waterskiers, who use the River up to the entrance to Arundel Swamp Brook. Parts of this stretch are narrow and pose a hazard to small boats and swimmers. Residents are also concerned about the noise and disturbance of speeding motorboats further upriver, and the washout their wakes are creating along the River banks. This problem could be readily controlled by extending the 5 m.p.h. speed limit to all of the Kennebunk River.

LONG-RANGE PLANNING RECOMMENDATIONS

Some concepts for large-scale, long term planning are recommended below:

1. Incorporate cluster housing into subdivision planning as a means of preserving open space;

2. Integrate wildlife planning into total planning:

   a. Use cluster housing to place living units close to roads and other access points, so large contiguous areas of land can be left completely wild, particularly in the higher diversity areas;

   b. Preserve protected wildlife corridors between adjacent wild areas so animals can move freely between these sites;

   c. Have a qualified local field biologist draw up a plan of contiguous wildlife areas and wildlife corridors for each town, so these areas can be planned for and preserved as part of a flexible long-range plan;

   d. Encourage a program of conservation easements for significant wildlife areas;

   e. Consider local rezoning for significant wildlife areas.

3. Select a local field biologist who could be available to the towns on a per diem basis; or as a part-time natural resource officer. This person could field-check the natural resource requirements of present and future ordinances and aid in site plan review for planning boards and other town officials.

   Specifically, a biologist could:

   a. Locate the normal high water mark along water bodies for shoreland zoning setback requirements;

   b. Field check a developer's delineation of a wetland by identifying wetland boundaries by vegetation and hydric soils;

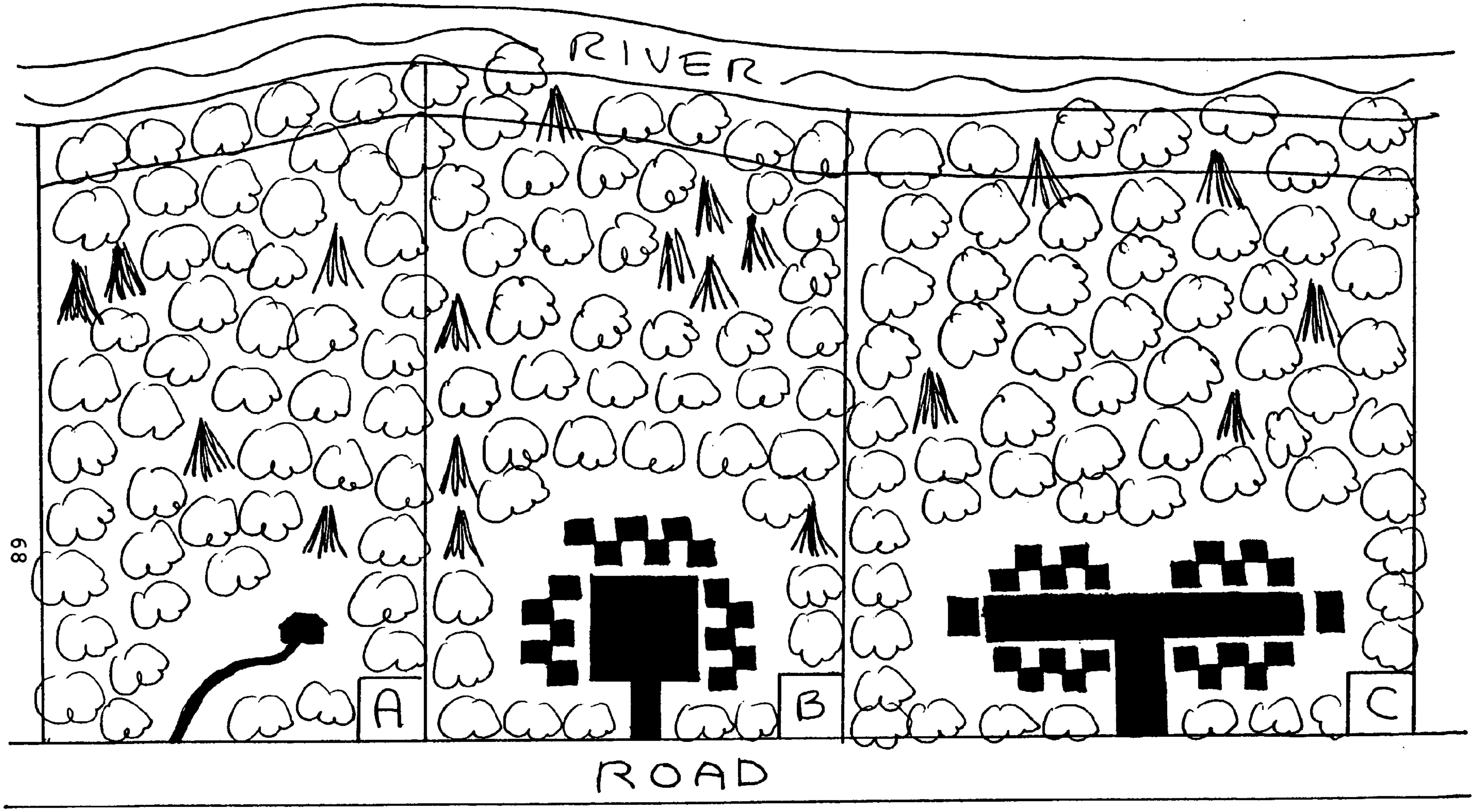

Fig. 5. This in an example of a working plan which will combine the preservation of a high diversity wildlife area with development. Property A: private residence with a conservation easement; B and C: cluster housing developments. Planned cluster housing near local roads allows large contiguous areas of wild land to be preserved. This kind of cluster housing also minimizes developer's expenses, as well as local taxes for ongoing town services such as school bus travel, police protection, and sewer hookups. Property owner A is preserving the land behind his residence in a completely wild condition, into perpetuity, through a conservation easement.

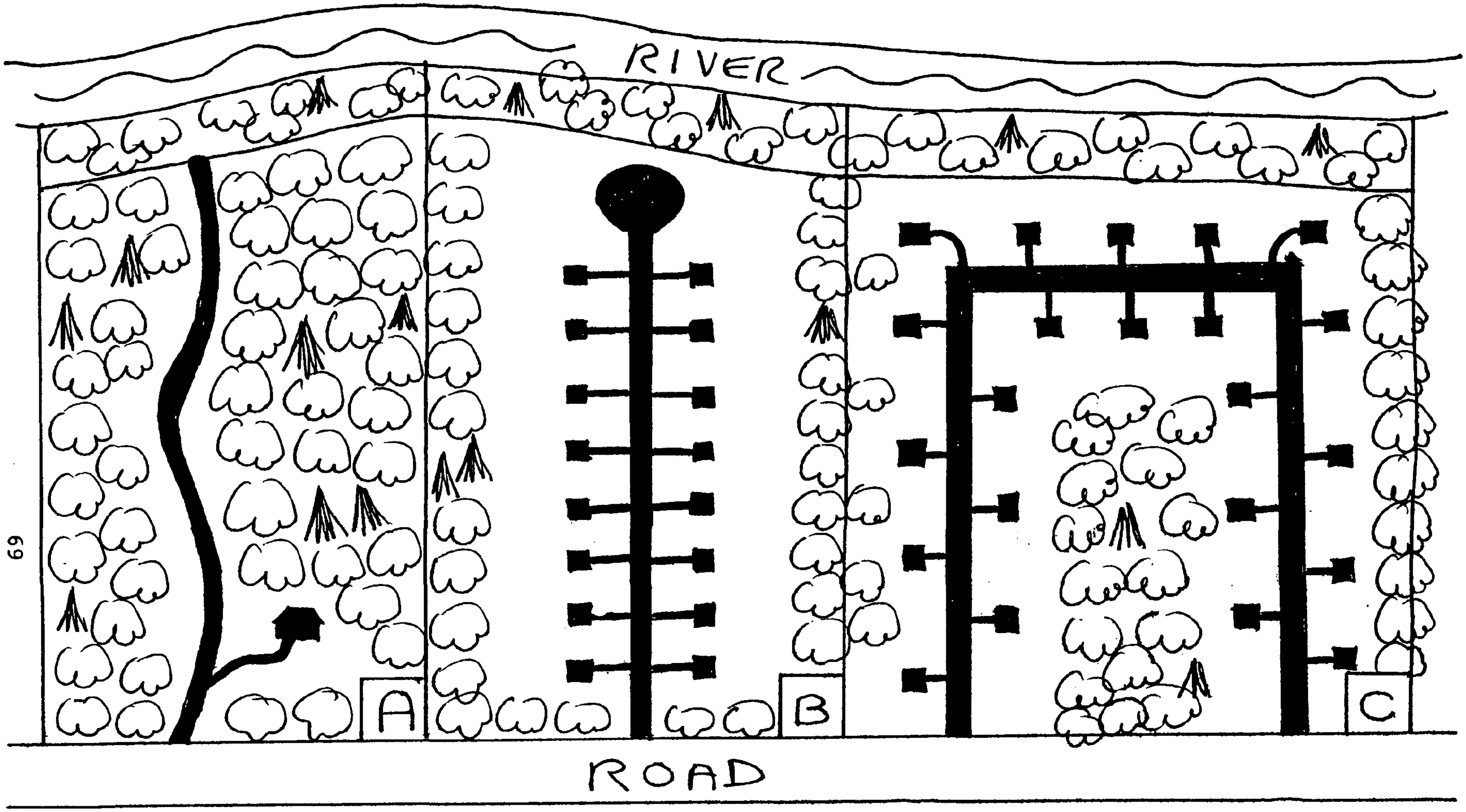

Fig. 6. A plan which will eliminate a high diversity wildlife area. The same properties and number of units are shown as in Figure 5. Here the developments are spread out, placing housing throughout the high diversity wildlife area. Human activities around the new housing will keep most wildlife away. This type of development further breaks up the remaining wild land into islands that can't be accessed by most wildlife, and creates additional expenses for town services.

The access road to the river on property A opens the area to potential human activity which will also keep wildlife away.

c. Measure the extent of spring runoff, spring tides, and annual storms on the extent of annual flooding extremes for clearer floodplain assessment;

d. Review site development plans in the field for potential problems;

e. Check that natural habitat had been properly restored following subdivision development;

f. Report and pursue environmental damage such as toxic waste dumping with the appropriate authorities.

Too often these activities are left to town employees or volunteer boards who are already overburdened with many other concerns.

4. Appoint an Oversight Committee in each town to review subdivision plans and make recommendations to the planning boards. Review questions could include:

   a. Does this housing design and site design fit the character of the town?

   b. Is this plan well-integrated into the landscape, or is it perpetuating a suburban expanse of grass and asphalt?

   c. Are there town subdivision regulations which are perpetuating design problems, and if so, how can they be modified?

   d. Do features of the subdivision minimize future town expenses for such features as school bus travel, sewage hookups, and police protection?

   e. Are historical artifacts, outstanding landscape features, wildlife corridors and conservation space, and previous public access to the site being preserved?

   f. Is the developer bonded in case the project is abandoned and roads, sewer systems, landscaping, etc. are left unfinished?

5. Establish up-to-date, well-documented, legally valid growth ordinances, so that growth can be gradual and controlled in each town;

6. Integrate natural resource planning into regional growth planning such as the York County 2000 process;

7. Encourage a new state system of property assessment which would eliminate the concept of "highest and best use". According to this provision, property assessments are now based on the use that will bring the highest profitability if the land is sold. Thus a homeowner who manages a woodlot or uses his land for agricultural purposes will find his property assessed instead for its development potential. This forces many property owners to partition and sell pieces of their land in order to cover their property tax liability. Because of this liability, many wild and scenic areas are being divided and lost.

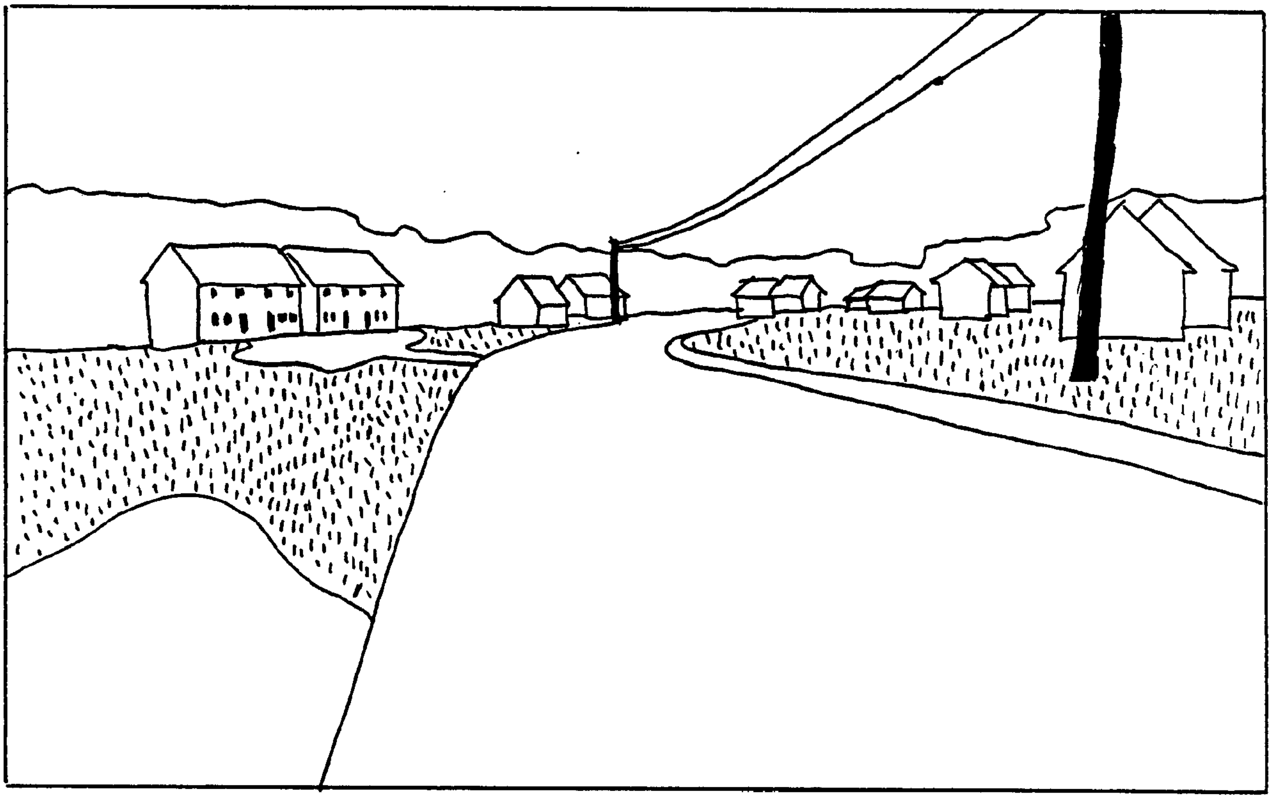

Fig. 7. Over half the units of the Powder Mill Development in Kennebunk are placed close to the Kennebunk River, with the majority of the remaining land in unproductive stretches of grass and asphalt.

By contrast, housing can be designed to match the Maine character and landscape, be clustered near local access roads, and be planned so that most of the natural and wild features of the landscape are preserved.

THE THREE-TOWN SUGGESTED ORDINANCE PACKAGE

SHORELAND ZONING AMENDMENTS

(Modified from the Shoreland Zoning Amendments for the Kennebunk Planning Board, SMRPC, 1985.)

I. Repeal section 3.10

II. Repeal section 3.11 and replace with the following:

3.10 Shoreland zones.

A. Resource Protection District:

1. Those lands lying within 330 feet of the normal high water mark of inland or coastal waters not included in the Limited Development District (Section 3.10 B).

2. Those lands identified as wetlands under the 1985 Maine Freshwater Wetlands Law, Chapter 485.

B. Limited Development District.

1. Those lands lying within 250 feet of the normal high water mark of:

a. The non-tidal portions of the following waterbodies:

1. The Mousum River from Main St. to a point 1000 feet to the south on the east side; and from Main St. 1000 feet to the north on the east side; and from Main St. 300 feet to the north on the west side.

2. Kennebunk River, within 200 feet north and south of Portland Rd (Route 1); and from the Route 9 bridge 750 feet to the north.

b. The tidal portions of the following waterbodies:
1. Atlantic Ocean, east of the peninsula of rocks separating Parsons Beach from Crescent Surf Beach.

III. Add the following definitions to section 4.1:

A. A Water Body shall include the following:

1. Tidal Area - any land or water area upon which tidal action occurs.

2. Pond - any inland impoundment, natural or manmade, which collects or stores surface water.

B. Water Courses shall include the following:

1. Stream and River - a free flowing drainage outlet, with its associated flood plain, with a defined channel, and containing flowing water for more than three months of the year.

2. Intermittant Streams - a free flowing drainage outlet, with its associated flood plain, with a defined channel, containing flowing water less than three months of the year.

B. Freshwater and Coastal Wetlands - all areas transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly wetland vegetation; 2) the substrate is predominantly undrained hydric soil; and/or 3) wetland hydrological conditions occur (a water table high enough to saturate the root systems of the native vegetation at least part of the year).

Wetland vegetation shall be defined as those species termed "hydrophytic" in the 1986 Wetland Plant List, Northeast Region, of the National Wetlands Inventory of the U.S. Fish and Wildlife Service.

Hydric soils are poorly drained or very poorly drained soils and are defined by Hydric Soils of the State of Maine, 1985, United States Department of Agriculture and Soil Conservation Service, and by Hydric Soils of Southern Maine, Soil Conservation Service, 1986.

Coastal Wetlands further include all tidal and subtidal lands, including all areas below any identifiable debris line left by tidal action, and all areas that contain vegetation tolerant of salt water and occur primarily in a salt water habitat, and any swamp, marsh, bog, beach, flat or other contiguous lowland which is subject to tidal action or normal tidal storm flowage at any time except during periods of maximum storm activity. Coastal wetlands may include portions of coastal sand dunes.

C. Frontage Shore - the horizontal distance, measured in a straight line, between the intersections of the lot lines with the shoreline at the normal high water mark.

D. Normal High Water Mark of Coastal Waters - along tidal bodies and water courses, the elevation where the vegetation changes from predominantly salt-tolerant hydrophytic plants to predominantly non-salt tolerant terrestrial plants; and/or the line on shores and banks showing where saltwater wetland soils (very poorly drained or poorly drained soils as defined by Hydric Soils of the State of Maine, 1985, United States Department of Agriculture and Soil Conservation Service, and by Hydric Soils of Southern Maine, Soil Conservation Service, 1986) meet upland soils; and/or where the water table exists within the vegetative root zone; whichever is higher. Salt-tolerant vegetation includes, but is not limited to, salt marsh grass, blackgrass, seaside lavender, seaside goldenrod, silverweed, salt marsh bulrush, seaside plaintain, sea orach, salt marsh aster, and salt marsh sedges. In places where vegetation is not present, the high water mark shall be the identifiable debris line left by the highest monthly non-storm tidal action. On a sand dune, the high water mark shall be the average seaward limit of salt-tolerant vegetation, or the high water mark on the seaward edge of a seawall or other manmade structure. Where inland rivers and tributaries are still tidal but support primarily fresh water plants the normal high water mark of inland waters shall be used. Where inland waters lie adjacent to the normal high water mark of tidal waters the normal high water mark of inland waters shall be used.

E. Normal High Water Mark of Inland Waters - the line where the freshwater vegetation changes from predominantly aquatic to predominantly terrestrial, and/or the line on shores and banks of non-tidal waters showing where wetland soils (very poorly drained and poorly drained soils as defined by Hydric Soils of the State of Maine 1985, United States Department of Agriculture and Soil Conservation Service, and by Hydric Soils of Southern Maine, Soil Conservation Service, 1986) meet upland soils; and/or where the water table exists within the vegetative root zone, whichever is higher. Aquatic vegetation includes, but is not limited to, water lilies, pondweeds, wild celery, arrowheads, pickeralweed, bur-reeds, sphagnum moss, Carex species and other sedges, rushes, reed grasses, plume grass, cotton grass, cattails, leatherleaf, alder, swamp dogwood, buttonbush, sweet gale, stunted black spruce, willows, white pine, and red maple. Terrestrial vegetation includes, but is not limited to, upland grasses, lady slipper, wintergreen, partridgeberry, sarsaparilla, Canada mayflower, sweet fern, low-bush blueberry, and black oaks. In places where the normal high water mark can not be immediately determined (due to ledges, erosion, etc.) it can be estimated from the nearest locations where wetland vegetation occurs.

IV. Repeal sections 5.10 and 5.11 and replace with:

5.10. Shoreland Zoning Districts.

A. The purposes as well as the general standards of these districts are to further safe and healthy conditions; prevent water pollution; conserve shore cover; prevent erosion and sedimentation; protect spawning grounds; protect fish and other aquatic life from increased temperatures, pollution, and habitat disturbance; provide a protective corridor for birds, mammals, and other wildlife through which they can move freely and where nesting and breeding habitat is preserved; control building sites, building structures, and land uses which could adversely affect the peacefulness, naturalness, and scenic beauty of water bodies; protect visual points of access as viewed from public facilities; conserve points of public access to waters; and prevent problems associated with floodplain development and use.

B. Resource Protection District.

1. The following activities and land uses are permitted within the resource protection district without the necessity for a permit from the town:

    a. Non-intensive recreational uses not requiring structures, such as hunting, fishing, and hiking;
    b. Motorized vehicular traffic on existing paved roads;
    c. Fire prevention activities;
    d. Soil and water conservation practices;
    e. Surveying and resource analysis;
    f. Emergency operations;
    g. Essential services accessory to permitted uses.

2. The following require a permit from the Code Enforcement Officer prior to commencement of any activity, after fulfilling the general standards listed in section 5.10.A.:

a. Timber harvesting under the following standards:

1. No more than 40% of the trees over 4 inches in diameter 3 feet up from the tree's base (3 feet dbh) shall be removed in any 10 year period in the zone 80-250 feet inland from the normal high water mark of inland or coastal waters (with no harvesting 0-80 feet inland from the normal high water mark except for the openings permitted in Section IV.5.10.B.8. of this ordinance or to remove an individual tree which threatens human health or safety);
2. Any tree stand shall be selectively cut with no opening in the tree canopy greater than 7500 square feet;
3. Canopy openings shall be placed at least 100' apart;
4. No harvesting will take place on slopes greater than 25° ;
5. No area of exposed soil due to skid trails, or other removal methods, will be made within 80 feet of the normal high water mark of inland or coastal waters;
6. No piles of slash will be greater than 4 feet in height, or closer than 80 feet to the normal high water mark of inland or coastal waters;
7. Harvesting shall take place in seasons when minimal erosion will take place;
8. Adequate provision shall be made to prevent soil erosion and sedimentation of surface waters.

b. Structures accessory to permitted uses;
c. Temporary piers, docks, wharves, causeways, and uses projecting into water bodies;
d. Filling or other earth-moving activity of less than 10 cubic yards.

3. The following uses require approval from the Zoning Board of Appeals as an exception under Section 7.7. prior to commencement of any activity, after fulfilling the general standards listed in Section 5.10.A.:

a. Clearing of vegetation for approved construction within 250 feet of the high water mark of inland or coastal waters;
b. Road construction;
c. Permanaent piers, docks, wharves, casueways, and

other uses projecting into waterways;
d. Small non-residential facilities for educational, scientific, or nature intrepetation purposes;
e. Filling, or earth moving, greater than 10 cubic yards.

4. All uses above, whether a permit is required or not, shall be subject to the performance standards in Section 6, where applicable.

5. Except for those structures requiring direct access to the water, all buildings and structures shall be set back the following distances from the normal high water mark of inland or coastal waters: 330 feet horizontal distance from a water course 5 feet wide or greater (in matters of dispute the width is measured by the average distance between the high water marks on each side of the water course; the average being taken by measuring the width every 50 feet and averaging the total for each 500 feet of frontage shore); 150 feet horizontal distance from a water course less than an average of 5 feet across and from intermittant streams; 330 feet horizontal distance from natural water bodies an average of 50 feet or more in diameter; and 150 feet horizontal distance from natural water bodies less than an average of 50 feet in diameter.

6. Manmade ponds are allowed up to a minimum horizontal distance of 50 feet from a structure, and up to 250 feet horizontal distance of the normal high water mark of inland or coastal waters.

7. No paved or unpaved roads or paved or unpaved parking lots shall be permitted within 330 feet horizontal distance of the normal high water mark of inland or coastal waters.

8. No building shall be erected on a site having an angle of slope greater than 25°; or on soils subject to slumping, mass movement, or severe erosion as described in the Soil Survey of York County, Maine, 1982, United States Department of Agriculture and Soil Conservation Service.

9. In order to preserve the scenic value of water bodies and water courses, to provide cool and shaded waters for fish habitat, and to preserve a natural shoreline wildlife corridor, the existing

natural vegetation shall be maintained according to standards recommended by the Dept. of Wildlife, University/Maine, Orono: no harvesting of trees or understory shall be permitted 80 feet horizontal distance inland from the normal high water mark of inland or coastal waters, while selective harvesting of trees shall be permitted at 80-250 feet horizontal distance inland of these points according to the standards listed in Section IV.5.10.B.2.a. of this ordinance. Clearing of trees to within 250 feet horizontal distance of the normal high water mark of inland or coastal waters is permitted for approved construction, and additional natural vegetation may be added in this area for landscaping. Cleared openings not greater than 25 feet in width may be created in a strip extending the length of the resource zone inland from the normal high water mark. At least 150 feet of frontage shore of natural shoreline vegetation as described in this section shall separate each 25 foot width clearing.

10. Agricultural clearing of land shall be allowed up to a minimum of 250 feet horizontal distance from the normal high water mark of inland or coastal waters.

11. Sanitary systems may be installed up to a minimum of 250 feet horizontal distance from the normal high water mark of inland or coastal waters.

C. Limited Development District.

1. Permitted uses, and uses permitted as exceptions within the the Limited Development District shall be the same as those which are applicable to the underlying zoning district in which they are placed, subject to the additional performance standards contained in Section 6, where applicable.

2. Within the Limited Development District no building or structure, except those requiring direct access to the water as an operational necessity, shall be constructed or enlarged within 75 feet horizontal distance of the normal high water mark of inland or coastal waters.

3. A vegetative edge of natural shrubs, or trees and shrubs, shall be preserved 25 feet horizontal distance inland from the normal high water mark of inland or coastal waters. Cleared openings not greater than 25 feet in width may be created inland

from this mark. At least 150 feet of frontage shore of natural vegetation as defined above shall separate each 25 foot width clearing.

4. No paved or unpaved roads or paved or unpaved parking lots shall be permitted within 75 feet horizontal distance of the normal high water mark of inland or coastal waters.

5. Manmade ponds are allowed up to a mimimum of 50 feet horizontal distance of a structure and up to a minimum of 25 feet horizontal distance from the normal high water mark of inland or coastal waters.

6. Sanitary systems are allowed no closer than a minimum of 100 feet horizontal distance from the normal high water mark of inland or coastal waters.

7. All uses within the Limited Development District shall be subject to Section 5.10.B.8.

D. General Standards.

1. Prior to the issuance of a permit by the Code Enforcement Officer or the granting of an exception by the Zoning Board of Appeals, the applicant shall demonstrate that the proposed use will meet all the conditions of section 5.10 A.

V. Amend section 7.6.C.2. by adding paragraph c:

c. A variance in the Shoreland Zones is authorized only for lot area, lot coverage by structures, and setbacks. A variance shall not be granted to permit a use or structure otherwise prohibited. In addition to the above standards, the Board of Appeals shall make written findings regarding the Shoreland Zones that the evidence presented demonstrates that the proposed use and structures would meet the provisions of section 5.10 A. A copy of all variances granted by the Board of Appeals in the Shoreland Zones shall be submitted to the Maine Department of Environmental Protection.

WETLANDS ORDINANCE

(Condensed and modified from the Final Proposed Floodplain and Conservation Area Ordinance, Town of Kennebunk, Adamus and Kehoe, 1982.)

I. The purposes and general standards of this ordinance are to:

A. Further safe and healthful conditions;

B. Prevent and control pollution of surface and ground water by excessive sedimentation, inorganic nutrients, toxins, and other substances;

C. Sustain fisheries of commercial and sport value by maintaining a proper balance of the transfer of nutrients from inland to coastal wetlands, and from coastal wetlands to offshore waters;

D. Protect spawning grounds;

E. Protect the habitats of fish, furbearers, and other water-dependent animals;

F. Retain the water-absorbtive capacity of wetlands to recharge groundwater supplies and release water slowly to streams, rivers, ponds, and lakes;

G. Reduce community and individual financial liability imposed by uncontrolled flooding;

H. Control land uses detrimental to the above purposes;

I. Protect the scenic and recreational values associated with coastal and inland beaches and wetlands.

II. Definitions of wetlands:

A. Coastal wetlands and freshwater (inland) wetlands and the definition of their limits (the normal high water mark) are defined in [section 4.1 of the proposed Shoreland Zoning Amendments].

B. Where a wetland gradually merges into upland, the normal high water mark shall be defined as that line where at least 50% of the plant stems are wetland species, or the line between hydric and non-hydric soils, or the line where plant roots are no longer saturated with water, whichever is higher. Wetland vegetation shall be defined as those species termed "hydrophytic" in the 1986 Wetland Plant List, Northeast Region, of the National Wetlands Inventory of the U.S. Fish and Wildlife Service.

III. Prohibited Uses.

A. No person shall dredge; drain; lagoon; excavate; grade; till; fill; or place structures, trash, garbage, slash, earth, rock, borrow, gravel, sand, clay, peat, or other materials or effluents upon; or allow highway runoff or drainage ditch effluents upon; or divert water flows into or out of; a wetland. Also, no person shall dike; dam; divert; operate off-road vehicles on; spray with defoliants or add to or take away from, or otherwise alter or cause to be altered, the character of any wetland, or lands, or construct a permanant building within the following distances: 330 feet horizontal distance from wetlands 10 or more acres in size, 150 feet horizontal distance from wetlands 1 - 9+ acres in size, and 75 feet from wetlands less than 1 acre in size. Exceptions include buildings permitted under Sections IV. and V.; and also lands around wetlands covered by the Limited Development Zone of the town Shoreland Zoning Amendments where the setback is 75 feet from a wetland.

B. Exceptions to III.A. of this ordinance are allowed for a man-made waterbody built next to an already constructed building where a setback of 50 feet is permitted. Such a waterbody shall not displace an already existing wetland.

IV. Permitted Uses.

A. The activities and land uses which are allowed without a permit are listed in [Section 5.10.B.1. of the Shoreland Zoning Ordinance].

B. Activities and land uses requiring a permit from the Code Enforcement Officer are listed in [Section 5.10.B.2. of the Shoreland Zoning Ordinance]. A permit shall be granted by the C.E.O. if these uses meet all the general standards listed in Section I of this Ordinace.

C. Activities and land uses requiring a permit from the Zoning Board of Appeals are listed in [Section 5.10.B.3. of the Shoreland Zoning Ordinance], provided they meet the general standards listed in Section I of this Ordinance.

D. All uses included above, whether a permit is required or not, shall be subject to the performance standards in Section 6, where applicable.

V. Amend Section 7.6.C.2. by adding the following paragraph:

A. A variance in a wetland and its surrounding protective lands is authorized only for lot area, lot coverage by structures, and setbacks. A variance shall not be granted to permit a use or structure otherwise prohibited. In addition to the above standards, the Zoning Board of Appeals shall make written findings regarding the Shoreland Zones that the evidence presented demonstrates that the proposed use and structures would meet the provisions of Section I of this Ordinance. A copy of all variances granted by the Zoning Board of Appeals in the Shoreland Zones shall be submitted to the Maine Department of Environmental Protection.

GROUNDWATER PROTECTION ORDINANCE

(This ordinance is taken directly from recommendations to the town of Kennebunk by SEA Consultants in "Groundwater Recharge Area Analysis and Planning", 1979.)

a. A minimum separation of 48 vertical inches be made between the bottom of a leach bed and the seasonal high groundwater table of an aquifer (DRASTIC categories of 151 or higher).

b. That solid waste facilities be prohibited over aquifer areas.

c. That industries utilizing wet chemical techniques yielding potentially toxic liquid wastes should be prohibited from aquifer areas.

*The Friends of the Kennebunk River recommends that these regulations be extended to all "potentially vulnerable" areas as well, i.e., DRASTIC categories of 111-150.

ORDINANCE TO ELIMINATE OVERBOARD DISCHARGE

(Taken directly from the Zoning Ordinances of the Town of Phippsburg.)

Overboard discharges from sewage disposal systems, wherein sewage or any part thereof, chlorinated or otherwise, is discharged directly into surface waters, is prohibited, excepting that systems installed prior to the passage of this amendment may continue as long as they are in compliance with all state water pollution laws and regulations. This prohibition also shall not apply to existing lots with existing buildings all of which were constructed prior to (date of ordinance), and which can not be made to conform to state and local plumbing codes by any other means than the overboard discharge of treated sewage. Nor shall this section apply to owners of lots who have obtained valid overboard discharge liscences prior to (date of ordinance).

SPEED LIMIT ORDINANCE

The 5 m.p.h. maximum speed limit presently in effect on the Lower Kennebunk River shall be extended to cover all of the Kennebunk River.

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APPENDIX A

NEW AND PROPOSED SUBDIVISIONS ON RIVER SYSTEMS IN ARUNDEL, KENNEBUNK, AND KENNEBUNKPORT, 1970-85

NEW AND PROPOSED SUBDIVISIONS ON RIVER SYSTEMS
IN ARUNDEL, KENNEBUNK, AND KENNEBUNKPORT,
1970-85

ARUNDEL
7 out of 26 total subdivisions on river systems

Kennebunk River Watershed:

Main Trunk of River:

AR - 5	Holmberg and Lager, River Road, Two lots directly on River.	3 lots	11.7A	1975
AR - 6	Bittersweet Farms, Jack Libby Realty, Rt. 35 - Bittersweet Lane and Hickory Lane, Three lots on River.	5 lots	52 A	1975
AR - 14	Riverwynde, sect. 2, River Rd., Meadow Lane, Three lots on River.	9 lots	5.5 A	1980
AR - 15	Riverbank, River Rd., All lots on River and bordered by Saunders Brook, 84 A preserved as wetland.	3 lots	16.4 A	1981
AR - 21	Meadow Lane Acres, Meadow Lane off Walker Lane, Houses on 3.5 A.	3 lots	8.2 A	1984

Goff Mill Brook:

AR - 12	Gertrude Morin, Rt. 1A	3 lots	17.8 A	1978

Duck Brook:

AR - 10	Alpine Acres,	7 lots	17.3	1978

Old Limerick Rd.
and Alpine Rd.

TOTAL:	34 lots	133 A

KENNEBUNKPORT
4 of 23 subdivisions on river systems

Batson River:

KP - 1	Bergeron Subdivision	19 lots	79 A	1979
KP - 11	Gerardi and Manthis, Mill Rd., Four lots on River wetlands.	15 lots	18 A	1972
KP - 19	Robt. LaRochelle, Lester Wildes Rd., Three lots border River or River trib.	4 lots	44 A	1983
KP - 21	"Division of Land", Lester Wildes Rd., One lot on River.	4 lots	43.2 A	1984

TOTAL:	41 lots	184 A

KENNEBUNK
14 out of 55 subdivisions on river systems

Kennebunk River watershed:

Main trunk of Kennebunk River:

KB - 13	River Locks, Off Old Port Rd., 6 units on River.	93 lots	84 A	1985
KB - 15	Summerfields III, Rt. 35., all units on River or Wonder Brook.	36 condos	24 A	1985
KB - 22	Port View, Port Rd., 16 units (4 buildings) on River.	21 condos	11.1 A	1974
KB - 44	Shirley Hale, Old Port Rd., 1 house on River.	3 lots	5 A	1983
KB - 47	Powder Mill, Off Portland Rd., 28 units (7 buildings) on River.	44 condos	19.4 A	1984

Wonder Brook:

KB - 15	Summerfields II, Route 35., 8 units (2 buildings) on Wonder Brook. Also see Summerfields III, above.	20 condos	6.9 A	1985

Mousum River watershed:

Main Trunk of Mousum River:

KB - 6	Riverbend Woods, 16 units (2 buildings) on River.	44 units	80 A	1983
KB - 17	River-dale, Ocean View Rd., off Sea Rd.	27 units	22 A	1970
KB - 20	Mousum Acres, Spiller Drive off Cat Mousum Rd., 8 units on River.	26 units	15.5 A	1973
KB - 23	J. Sherbourne, Spiller Drive off Cat Mousum Rd., all houses on River.	3 lots	3 A	1974
KB - 40	Sea Fields, off Sea Rd., all units separated from Mousum by wetlands buffer zone.	36 units	18.4 A	1982
KB - 45	Mousum Ridge, Brown St. 7 acres preserved btw. dev. and River.	26 units	19.5 A	1983
KB - 49	High Bluff, Fletcher St., all units on River.	16 units	4.5 A	1984

Day Brook:

KB - 32	Priscilla Cook	5 units	16.1 A	1979
	TOTAL:	400 units	330 A	
	GRAND TOTAL, 3 TOWNS:	475 units	647 A	

APPENDIX B

COMMERCIAL, PRIVATE, AND PUBLIC ENTERPRISES ON THE LOWER RIVER AND THE KENNEBUNK RIVER BASIN

I. Commercial, Private, and Public Enterprises Directly on the Lower River

II. Commercial and Private Businesses Directly on the Kennebunk River Basin

I.Commercial, Private, and Public Enterprises Directly on the Lower River

Commercial Marinas

Marina	Berths	Total Transients
Arundel Shipyard	23	30
Arundel Wharf Restaurant	10-15	0
Chick's Marina	40	680
Kennebunkport Marina	42	NA
Nonantum Hotel and Motor Inn	40	0
Reid's Boatyard	35-40	0
The Yachtsman Marina	40	NA
TOTAL:	230-240 commercial berths	710+ transients

Private Marinas and Docks

Marinas/Docks	Berths
Arundel Yacht Club	34 for large boats, 15-20 for small.
Doane's Wharf	6
Kennebunk River Club	30-35
Kennebunkport Maritime Museum	1-3
The Landing	

Restaurant	1
Schooners Inn and Restaurant	5
TOTAL:	92-104 private berths

Public Moorings

Sailboats	25
Lobster boats	15
Fishing boats	2
TOTAL:	42

Cruise and Fishing Boats

Vessel	Type of Business	Maximum Carried
The Deepwater	Deep sea fishing	30
The Sonnie W.	" " "	32
Cap'n Al	" " "	40
The Vendor	" " "	20
The Nautilus	Whale watching	100
The Indian	" "	70
The Elizabeth II	Cruise boat	49
The Discovery	Sailing	6
TOTAL:		347 passengers

Hotels, Inns, and Motor Inns

Business	Units
The Breakwater	22
The Landing Hotel	8
Nonantum Hotel & Motor Inn	62 (expanding 54 units)
Schooner's Inn and Restaurant	17
The Yachtsman Motor Inn	30
TOTAL:	139 units

Restaurants and Take-outs

Restaurant	Seats
Arundel Wharf Restaurant	200
Breakwater Restaurant	105
Ciao! Cafe	50
The Landing Restaurant	190
Nonantum Restaurant	100-200
Plain & Fancy Bagel Cafe	16
Schooners Inn & Restaurant	48
TOTAL:	709-809 seats

Shops and Galleries

1. Port Sports, kennebunkport Marina
2. Kennebunkport Maritime Museum Shop
3. The Schooners:
   a. Provisions
   b. Antiques Windfall
   c. Beauty Salon
   d. Flower Lady
   e. The Dannah Collection
   f. Fiori
   g. Schooners Limited
   h. Heritage House Antiques
   i. Rands of Rand Green
4. Boutique Marguerite
5. Port Antiques
6. The Pasco's American Handcrafts
7. Wharf Lane:
   a. Priscilla Hartley Gallery
   b. Van Sindern Woodworking
   c. Goose Rocks Pottery
8. Nancy St. Lawrence Gallery
9. Seawinds Gallery
10. Gazelle
11. The Pig and Saddle Ltd.
12. S Brook:
    a. The Zoo Apparel
    b. Cove's End
    c. Soap Opera
    d. Alano Ltd.
    e. Port-Loft Gallery
    f. Pink Cornucopia
    g. Whats-in-a-Store?
    h. Village Barber Shop
    i. Julia's Gift Shoppe
    j. Kennebunk Book Port
    k. Copper Candle
    l. Annie's Apple
    m. Mainely Rugs
    n. Port Canvas Co.
    o. Metal and Wicker
    p. The Good Earth
    q. The Omega Jewelry Shop
    r. Xmas Presents
13. Goodies
14. Wooden Wildlife
15. R. and R. Leather

TOTAL: 42 shops and galleries

Other Businesses and Educational Enterprises

1. Chick's Marina Boat Supplies
2. Arundel Boatyard Boat Supplies
3. Yacht Brokerage, Yachtsman Motor Inn
4. Shanley Real Estate
5. Shackford and Gooch (seafood)
6. Kennebunkport Maritime Museum

II. Commercial and Private Businesses Directly on the Kennebunk River Basin

Shops, Studios, and Galleries

1. Port Sports
2. The Boatyard:
   a. House of Brass
   b. The Hearth
   c. Port Video
   d. Canoe Stitch
3. The Snappy Turtle
4. The Glass Collection
5. Cooper-Funk Gallery
6. Ron Goyette Studio
7. Meserve's Market
8. Cutaway

Restaurants

Port View Restaurant	70
The Chef's Whim	28-36
TOTAL:	98-106 seats

Offices

Dr. Peter V. Brask, dentist

APPENDIX C

TESTING RESULTS ON THE RIVER

I. Maine Department of Environmental Protection Tests,
8/5/80-9/26/83

II. Friends of the Kennebunk River Tests,
6/22/85-9/19/86

D.E.P. - 8/05/80 - 10/01/81

Route 9 Bridge

Date	80/08/05	80/10/07
Time; depth of bottom	1100 0001	1030 0001
Water temp., C	19.2	13.0
Water temp., F	66.6	55.4
Turbidity		0.6
Conductivity	48200	
D/O/ml	9.3	11.4
Percent saturated D/O	100.0	107.5
5 day BOD, mg/1	2.0 K	2.0 K
Ph	7.80	7.60
Salinity	22.0	
Total coliform/100 ml	2300	10 K
Fecal coliform/100 ml	104	6

Date	81/02/12	81/03/05	81/05/14	81/06/17	81/07/08	81/08/06	81/10/01
Time; depth of bottom	1005 0001	1000 0001	0930 0001	1115 0001	1020 0001	1000 0001	1030 0001
Water temp., C	0.0	2.5	8.5	12.0	22.0	20.0	10.5
Water temp., F	32.0	36.5	47.3	53.6	71.6	68.0	50.9
Turbidity	28.0	0.8		0.7	4.6	3.9	1.1
Conductivity	1820	20500					15
D/O/ml	13.8	13.0	11.2	12.1		7.2	40000
Percent saturated D/O	94.0	96.0	94.0	112.0		78.3	
5 day BOD, mg/1	6.0	2.0 K	2.0 K		2.0 K	2.0 K	
Ph	6.00	7.90	7.60	7.80	7.30	7.80	7.70
Salinity		11.0					25.0
Total coliform/100 ml	880	14	2	32	4000	480	70
Fecal coliform/100 ml	300	12	1 K	10	900	410	30

D.E.P. - 1/20/82 - 2/22/83

Route 9 Bridge

Date	82/01/20	82/02/24	82/03/31	82/04/14	82/05/18	82/06/03	82/08/11
Time; depth of bottom	1145 0001	1330 0001	1100 0001	0915 0001	1200 0001	1330 0001	1030 0001
Water temp., C	0.0	2.0		3.0	15.0	17.0	
Water temp., F	32.0	35.6		37.4	59.0	62.6	
Turbidity	2.2	4.5		8.3		21.0	9.2
	15						
Conductivity	25000	41000		660	263	360	1200
D/O/ml	16.4				9.2		
Percent saturated D/O	112.3				90.2		
Ph	7.20	8.22		6.82	7.20	6.10	
Salinity		24.0			16.0	1.0 K	
Total coliform/100 ml	550	2 K	840	1900	700	7500	9900
Fecal coliform/100 ml	142	2 K	20	60	14	4200	820

Date	82/09/14	82/10/07	82/11/09	82/12/02	83/01/24	83/02/22
Time; depth of bottom	1430 0001	1330 0001	1230 0001	1100 0001	1100 0001	1520 0001
Water temp., C	19.0	14.0	8.5	10.0	2.0	4.0
Water temp., F	66.2	57.2	47.3	50.0	35.6	39.2
Turbidity	1.8	1.2	2.6	3.2		4.0
Conductivity	35340	33540	22500		14000	15660
D/O/ml	8.2					
Percent saturated D/O	87.3					
Ph		6.80	7.40	7.60	6.80	
Salinity	22.0	17.0	13.0	20.0	7.0	10.0
Total coliform/100 ml	100	300	2000			
Fecal coliform/100 ml	40	200	200	4	142	10 K

D.E.P. - 6/14 - 9/26/83

Route 9 Bridge

Date	Sta. #	Tide	Substra	W Temp°F	D.O.	A Temp°F	Total Coli	Fecal Coli
830614	C6-6	L	md	50°		76°	1100+	1100+
830620	C6-6	F	md	68°		76°	1100+	1100+
830628	C6-6	L	md	58°		76°	2400+	2400+
830711	C6-6	L	md	64°		72°	9.1	
830719	C6-6	H	md	66°		76°	460	460
830802	C6-6	E	md	65°		84°	1100	210
830809	C6-6	F	md	65°		82°	240	93
830823	C6-6	F	md	62°		80°	1100+	1100
830830	C6-6	L	md					
830913	C6-6	E	md	64°		68°	1100+	1100
830919	C6-6	F	md					
830926	C6-6	F	md	64°		64°	1100+	1100+

D.E.P. – 5/26 – 8/31/83

STATION K130 (DURRELL'S BRIDGE)

WATER BODY Kennebunk River TOWNSHIP Kennebunk–Arundel line

DATE	CODE	D.O. SATURATION	FECALS PER 100 ml	TIME	°C	D.O. mg/l	DEPTH SAMPLE	STAGE	RUNOFF	COMMENTS
5/26/83		94%	350	10.50	13	10.3	1	tidal	no	
6/14/83		87%	220	11.20	20°	8.0	1	tidal	no	Salinity <1‰
6/28/83		88%	200	11.20	21.5	7.8	6"	tidal	no	Salinity 2‰
7/13/83		98	240	11.05	20	9.0	1'	tidal	no	Salinity 1.5‰
7/26/83		87	370	10.45	20	8.0	1'	tidal	maybe	Salinity 1‰ tide coming
8/3/83		98	90	10.30	24	8.3	[illegible]	tidal	no	Salinity 7‰
8/31/83		71	470	9.50	21	6.4	1'	tidal	yes	Salinity 7‰

D. E. P. - 5/26 - 8/31/83

STATION K90 (ROUTE 1)

WATER BODY Kennebunk River TOWNSHIP Kennebunk-Arundel line

DATE	CODE	D.O. SATURATION	FECALS PER 100 ml	TIME	°C	D.O. mg/l	DEPTH SAMPLE	STAGE	RUNOFF	COMMENTS
5/26/83		94%	60	10.40	12.0	10.2	1'	1	no	
6/14/83		94%	130	11.00	20°	8.6	1'	19'	no	
6/28/83		99%	90	10.45	19.5	9.2	6"	19.5'	no	
7/13/83		108	30	10.35	20.5	9.8	6"	19.5	no	
7/26/83		96	410	10.20	19	9.0	6"	19.5	maybe	
8/3/83		110	120	10.15	25	9.2	1'	20'	no	
8/12/83		85	520	9.50	18	8.1	1'	20'	yes	Storm &
8/31/83			330	10.45			1'	19.5'	yes	storm

D.E.P. - 5/26 - 8/31/83

STATION K60 (DOWNING ROAD)

WATER BODY Kennebunk River TOWNSHIP Kennebunk-Arundel line

DATE	CODE	D.O. SATURATION	FECALS PER 100 ml	TIME	°C	D.O. mg/l	DEPTH SAMPLE	STAGE	RUNOFF	COMMENTS
5/26/83		92%	10	10.10	13°	9.8	1'	1	no	
6/14/83		90%	210	10.40	18'	8.6	1'	12.5	no	
6/28/83		85%	40	10.20	18.5	8.0	6"	13.5	no	
7/13/83		89	110	10.00	18.5	8.4	6"	14'	no	
7/26/83		85	230	9.55	18.5	8.0	6"	13'	maybe	
8/3/83		82	60	9.45	21.5	7.3	6"	14'	no	
8/12/83		72	800	10.10	17	7.0	6"	14'	yes	Storm event
8/31/83			630	11.20			6"	14'	yes	Storm event

D.E.P. - 5/26 - 8/31/83

STATION K40 (DAYS MILLS)

WATER BODY Kennebunk River TOWNSHIP Kennebunk - Arundel line

DATE	CODE	D.O. SATURATION	FECALS PER 100 ml	TIME	°C	D.O. mg/l	DEPTH SAMPLE	STAGE	RUNOFF	COMMENTS
5/26/83		97	20	9.40	12.5	10.4	1'	1	no	
6/14/83		107	270	9.40	18.0	10.2	1'	1	no	
6/28/83		91	110	9.40	18.5	8.6	6"	1/2	no	
7/13/83		98	110	8.50	18.5	9.2	6"	1/2	no	26' to water lev
7/26/83		90	400	9.20	18	8.6	6"	26.5	maybe	
8/3/83		95	260	9.15	20.5	8.6	6"	26'	no	
8/31/83			1400	11 55			6"	26.5'	yes	Storm event

		FRIENDS OF THE KENNEBUNK RIVER															
		RIVER MONITORING TEST DATA			6/22/85 - 9/19/86												
DATE	TIME	LOCATION	TEMP	DO/PPM	PH	AMONIA	NO2	NO3	CHLOR	T.COLI	F.COLI	WIND	TIDE	CLOUD C	SALT	LAST STM	COMMENTS
6/22/85	9:45	RT.9 BRIDGE	20°C	7.70	8	0.36	0.00	0.00				LOW	LOW	LIGHT	19PPM	14HRS	TIDE HAS JUST STARTED TO CO
6/22/85	9:30	RT.1 BRIDGE	65°F	8.70	7.10	0.40	0.00	0.00								"	
6/22/85	9:40	DURREL BRG	67°F	7.70	7.30	0.50	0.00	0.00					LOW			"	DEAD TIDE
7/7/85	10:00	RT. 9	70°F	7.10	7.50	0.00	0.00	0.00	0.00			LOW			20PPM		TIDE GOING OUT
7/7/85	"	RT. 1	75°F	6.20	7.00	0.10	0.00	0.00									MISTAKE ON DO
7/7/85	"	DURREL BRG	73°F	7.10	7.30	0.40	0.00	0.00	0.00			LOW					TIDE GOING OUT
7/29/85		DURREL BRG					0.00	0.00									
8/24/85	16:15	RT.9 BRG	67°F	8.40	8.00	0.00	0.00	0.00				LOW	IN	P. CLDY		48HRS	HIGH TIDE AT 18:00 HRS
8/24/85	16:15	RT.1 BRG	71°F	9.30	7.50	0.50	0.00	0.00				LOW	NONE	P. CLDY		48HRS	HIGH TIDE AT 18:00 HRS
8/24/85	16:15	DURREL BRG	71°F	9.10	7.60	0.40	0.00	0.00				LOW	IN	P. CLDY		48HRS	HIGH TIDE AT 18:00 HRS
9/29/85	17:00	DURREL BRG	17°C	6.00	6.80	0.80	0.00	0.00				LOW	LOW	CLEAR		40HRS	HURRICANE ON FRIDAY NIGHT
9/29/85	18:00	RT. 1 BRG	18°C	8.40	6.10	1.00	0.00	0.00				LOW		CLEAR		"	" " "
9/29/85	18:30	RT. 9 BRG	17°C	7.80	7.00	0.70	0.00	0.00				LOW	LOW	"		"	" " " " " TI
10/12/85	15:31	DURREL BRG	11°C	9.30	6.90	0.75	0.00	0.00			120	LOW	HIGH	CLEAR		36HRS	TIDE GOING OUT
10/12/85	15:31	RT. 1 BRG	13°C	9.70	6.60	0.80	0.00	0.00			141	LOW	NONE	"		"	" " "
10/12/85	15:31	RT. 9 BRG	12°C	8.90	7.90	0.00	0.00	0.00			150	LOW	HIGH	"		"	" " "
11/24/85	15:00	DURREL BRG	4°C	12.70	6.70	0.30	0.00	0.00					LOW	P.CLDY			DEAD TIDE- LOW 1 HOUR BEFORE
11/24/85	15:00	RT. 1 BRG	2.5°C	13.10	6.30	0.40							NONE	"			" " " " " "
11/24/85	15:00	RT. 9 BRG	5°C	9.90	7.40	0.60							LOW	"			" " " " " "
3/8/86	10:25	RT. 1 BRG	0°C	13.20	6.00	0.20						HIGH	NONE	CLEAR		OVER 48HRS	AIR TEMP 16°F RIVER ICED OVER
3/8/86	10:30	DURREL BRG	0°C	13.50	6.30	0.20							HIGH				ICE BROKEN UP BUT MANY BERGS
3/8/86	10:45	RT. 9 BRG	1°C	12.90	7.70	0.00							HIGH				
3/8/86	15:45	RT. 1 BRG	0°C	13.30	6.30	0.20						HIGH		CLEAR			AIR TEMP 24°F
3/8/86	15:35	DURREL BRG	0°C	12.90	6.40	0.20							LOW				
3/8/86	15:35	RT. 9 BRG	0°C	13.00	7.10	0.20							LOW				
4/5/86	9:15	RT. 1 BRG	6°C	12.30	6.50	0.60						LOW		CLEAR		OVER 48HRS	HIGH TIDE AT 8:13
4/5/86	9:26	DURREL BRG	6°C	11.00	6.80	0.50							HIGH				AIR TEMP 52°F
4/5/86	9:30	RT. 9 BRG	7°C	11.40	7.70								HIGH				AMONIA TOO CLOUDY
4/26/86	10:45	RT. 1 BRG	12°C	9.80	6.90	0.40						NONE		RAIN		NOW	LIGHT DRIZZEL AIR 50°F
4/26/86	11:00	DURREL BRG	11.5°C	9.90	6.80	0.80							1/2FULL				RAIN IN LAST 24 HRS
4/26/86	11:00	RT. 9 BRG	8.9°C	10.00	7.90	0.00							HIGH				
5/27/86	19:35	RT. 1 BRG	15°C	8.70												LAST 24 HR	TEMP IN 80'S
5/27/86	19:45	DURREL BRG	17°C	8.80		0.60							1/2FULL				TIDE FULL AT 9PM
5/27/86	19:50	RT. 9 BRG	15°C	8.70	7.20								HIGH				
5/31/86	6:30	RT. 1 BRG	17°C	8.70	6.70	0.00											TEMP ABOUT 70°F
5/31/86	6:45	DURREL BRG	16°C	8.50	7.40								FULL	LT RAIN		NOW	TIDE JUST GOING OUT
5/31/86	7:10	RT. 9 BRG	12°C	9.30	7.80								FULL				HOT WEATHER & RAIN THIS WEE
6/21/86	6:45	RT. 1 BRG	18°C	9.50	6.80	0.80						HIGH		CL		48HRS	AIR TEMP 67°F
6/21/86	7:05	DURREL BRG	17°C	8.30	7.00	0.80							FULL				NEAR FULL, MUDDY H20
6/21/86	7:15	RT. 9 BRG	15°C	9.00	7.90								FULL				HEAVY RAIN THIS WEEK
6/29/86	13:00	RT. 1 BRG	25°C	8.30	7.20	0.60								CL			AIR TEMP 78°F
6/29/86	13:30	DURREL BRG	23°C	7.80	7.20	0.20							LOW				DEAD LOW AT DURRELS
6/29/86	13:40	RT. 9 BRG	19°C	7.80	7.80								LOW				
7/7/86	17:35	RT. 1 BRG	22°C	7.80	6.90	0.50								CL			AIR TEMP IN 80'S
7/7/86	17:45	DURREL BRG	22°C	8.00	6.90	0.50							1/2FULL				LOW TIDE AT 19:00
7/7/86	18:00	RT. 9 BRG	22°C	7.80	7.70								NEAR LOW				
8/16/86	10:25	RT. 1 BRG	20°C	8.40	7.00	0.80					388.00	NONE		CLOUDY		1HR	AIR TEMP 74°F PECK LABS ON C
8/16/86	10:40	DURREL BRG	21°C	7.90	7.60						188.00		HIGH				HIGH TIDE AT 8:45
8/16/86	10:55	RT. 9 BRG	18°C	8.20	8.20						53.00		HIGH				NEAR FULL GOING OUT
9/19/86	10:30	RT. 1 BRG	15.5°C	10.00	7.80	3.40					260.00						
9/19/86	"	DURREL BRG	17°C	9.80	7.70	1.50					160.00						LAB TESTS BY PECK
9/19/86	"	RT. 9 BRG	16°C	8.90	7.80	1.50					42.00						SAMPLES BY FRAN

APPENDIX D

WETLAND PLANTS AND SOILS

I. Common Wetland Plants Seen
Along the Kennebunk River System and their Status

II. Common Plants Which Grow Only in Upland Conditions

III. Hydric Soils of York County and Their Characteristics

I. Common Wetland Plants Seen Along the Kennebunk River and Their Status

All these plants are listed in the 1986 Wetland Plant List of the National Wetlands Inventory. Because some of these plants also grow in upland conditions, their percent wetland status from the Wetland Plant List is given in the right-hand column. The abbreviations stand for the following:

Obl - obligate; always found in wetlands under natural conditions.

Facw - facultative wetland; found in wetlands at a 66-99% frequency.

Fac - faculative; found in wetlands with a 33-66% frequency.

Facu - facultative upland; found in wetlands with a 1-33% frequency.

Saltmarsh plants:

Pitch pine	Pinus rigida	facu
Smooth cordgrass	Spartina alterniflora	obl
Saltmeadow cordgrass	Spartina patens	obl
Blackgrass	Juncus girardii	facw+
Chairmaker's rush	Scirpus americana	facw
Seaside goldenrod	Solidago sempervirens	facw
Saltmarsh aster	Aster tenuifolius	nc
Seaside plantain	Plantago maritima	facw
Sea lavender	Limonium carolinianum	obl
Glasswort spp.	Salicornia spp.	obl
Sea orach	Atriplex patula	facw
Silverweed	Potentilla anserina	obl
Seaside gerardia	Gerardia maritima	----

Freshwater plants:

White pine	Pinus strobus	facu
Red maple	Acer rubrum	fac
Black Spruce	Picea mariana	facw-
Eastern Hemlock	Tsuga canadensis	facu
Slippery elm	Ulmus rubra	fac
Northern red oak	Quercus rubra	facu
White ash	Fraxinus americana	facu
Speckled alder	Alnus rugosa	facw+
Highbush blueberry	Vaccinium corymbosum	facw-

European buckthorn	Rhamnus frangela	na
Elderberry	Sambucus canadensis	facw-
Arrowwood	Viburnum recognitum	facw-
Witherod	Viburnum cassinoides	facw
Highbush cranberry	Viburnum trilobum	facw
Willows	Salix spp.	fac+-obl
Common cattail	Typha latifolia	obl
Narrow-leaved cattail	Typha angustifolia	obl
Skunk Cabbage	Symplocarpus foetidus	obl
False Hellebore	Veratrum viride	facw+
Cardinal flower	Lobelia cardinalis	facw+
Jewelweed	Impatiens capensis	facw
Marsh St. Johnswort	Hypericum virginicum	----
Bur marigolds	Bidens spp.	facw-obl
Bur-reeds	Sparganium spp.	obl
Slender blue flag	Iris prismatica	obl
Spirea	Spiraea latifolia	na
Wild clematis	Clematis virginiana	fac
Spotted Joe-Pye-Weed	Eupatoriadelphus maculatum	facw
Tall meadow rue	Thalictrum pubescens	facw+
Arrow-lvd Tearthumb	Polygonum sagittatum	obl
Wild Mint	Mentha arvensis	facw
Closed Gentian	Gentiana andrewsii	facw
Swamp candles	Lysimachia terrestris	obl
Sensitive fern	Onoclea sensibilis	facw
Marsh fern	Thelypteris thelypteroides	facw+
Ostrich fern	Matteuccia Struthiopteris	facw
Lady fern	Athyrium Filix-femina	fac
Cinnamon fern	Osmunda cinnamomea	facw
Royal fern	Osmunda regalis	obl
Bracken	Pteridium aquilinum	facu
Carex sedges	Carex spp.	fac-obl
Rushes	Juncus spp.	fac-obl
Woolgrass	Scirpus cyperinus	obl
Canary grass	Phalaris canariensis	facu
Common reed	Phragmites australis	facw
Sphagnum moss	Sphagnum spp.	obl
Pickeralweed	Pontederia cordata	obl
Arrowheads	Sagittaria spp.	obl
Wild celery	Ruppia maritima	obl
Water shield	Brasenia schreberi	obl
Bullhead lily	Nuphar variegatum	obl

II. Common Plants Which Grow Only in Upland Conditions

Black oak	Quercus velutina
Crabapples	Pyrus spp.
Sweet fern	Comptonia peregrina
Low-bush blueberry	Vaccinium vacillans
Whorled wood aster	Aster acuminatus
Round-leaved pyrola	Pyrola elliptica
Shinleaf	Pyrola rotundifolia
Wintergreen	Caultheria procumbens
Pipsissiwa	Chimaphila umbellata
Sarsparilla	Aralia hispida
Bull thistle	Circium vulgare
Common milkweed	Asclepias syriaca
Spreading dogbane	Apocynum androsaemifolium
Purple vetch	Vicea americana
Ox-eye daisy	Chrysanthemum leucanthemum
Burdock	Arctium tomentosum
Queen Anne's lace	Daucus carota
Dodder	Cuscata granovii

III. Hydric Soils of York County and Their Characteristics

A hydric soil is defined as "a soil that in its undrained condition is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation" (USF&WS National Wetland Classification System, Cowardin, et al., 1979).

There are two general groups of hydric soils: very poorly drained soils, and poorly drained soils. These include:

Very Poorly Drained Soils

These soils fall into two categories: organic and mineral soils.

Very poorly drained organic soils have organic materials which extend from the surface to a depth of 16+ inches, and are saturated with water for 6 or more months. They occur in depressions, bogs, marshes, and swamps that have a slope of 2 percent or less (SCS, 1986). In York County these include:

Soil Name	Soil Map Symbol	Description and Location
CHOCORUA	Ch	Peat deposits 16-51" deep in swamps and bogs formed in plains and uplands over sand and gravel deposits.
SEBAGO	Sg	Thick peat deposits (51"+) in swamps formed in plains and uplands.
SULFIHEMISTS	SU	Thick saltmarsh saltwater grass deposits (51"+).
VASSELBORO	Va, Vp	Thick peat deposits (51"+) formed in kettleholes and depressions over glacial outwash plains and kame terraces.
WASKISH	Wa	Thick peat deposits (63"+) in sphagnum moss bogs.

Very poorly drained mineral soils are very wet soils that have a water table near or at the soil surface sometime during the growing season. All these soils are found from very deep levels to bedrock. They occur in lowlands, flats, and depressions, and usually have slopes of 2 percent or less. In York County this includes one soil type:

BIDDEFORD	Bm	Mucky peat deposits 8-15" thick from wet meadows and swamps, and the clayey marine sediments they are formed in.

Poorly Drained Soils

Poorly drained soils are wet soils with a watertable near the surface some time during the growing season. These conditions are caused by low hydraulic conductivity and/or seepage. All are found from deep levels to bedrock. They occur in depressions and at the base of slopes and have slopes of 8 percent of less. They include:

Soil Name	Soil Map Symbol	Description and Location
BRAYTON	Brb, Bsb	Deep fine sandy loam (60"+), with a perched water table near surface.
RAYNHAM	Ra	Deep silt loam (60"+), with water table at or near surface most of growing season.
RUMNEY	Ru	Deep loam and sandy loam (60"+), with water table at or near surface for most of growing season
SCANTIC	Sc	Deep silt loam and silty clay (60"+), with water table at or near surface most of growing season.
URBAN LAND - SCANTIC COMPLEX	UsA	Deep silt loam and silty clays (60"+), of mixed urban soils and poorly drained Scantic soils (USDA & SCS, 1985b, and SCS 1986).

APPENDIX E

WILDLIFE DIVERSITY

I. Wildlife Diversity Index

II. Method for Relating Development to Wildlife Diversity

I. Wildlife Diversity Index

Wildlife diversity was measured by walking along the riverways of the Kennebunk River system and recording the variety and frequency of animal signs (tracks, scats, trails, etc.) per unit distance.

This index can be used for upland as well as riverine situations. It could also be applied to other regions of Maine; as the index is based on the frequency of signs seen rather than the exact species of animals represented. Even on small sections of the Kennebunk River System, species can differ greatly depending on the changing nature of the surrounding habitat.

I. HIGH DIVERSITY. Remote or little visited wild areas, averaging 0.43 miles from the nearest residence (or closer if access blocked by a natural or physical structure such as a cliff or highway).

A minimum of any consecutive arrangement of any of the following:

a. Any recent beaver activity# if ponds are still intact;
b. Concentrations* of shorebirds, wading birds, grouse, wood duck, snowshoe hare, mink, muskrat, otter, porcupine, raccoon, woodchuck, beaver, fox, deer, and moose;
c. Common** sightings of woodcock, kingfishers, hawks, and passerines;

#Beaver ponds create high diversity areas for the length of their ponding and marsh effects.

*Concentrations - signs of an average of 4 individuals of a species within 100 yards.

**Common - signs of an average of 2 individuals of a species within 200 yards.

II. MEDIUM-HIGH DIVERSITY. Lightly visited areas near riverways averaging 0.25 miles from the nearest residence. Includes farms, areas of light timbering, light hiking and and snowmobile use.

A minimum of any consecutive arrangement of any of the following:

a. Common sightings of shorebirds, wading birds, woodchuck, raccoon, fox, and deer;
b. Occasional@@ woodcock, grouse, wood duck, hawks, owls, woodchuck, mink, porcupine, otter, moose.

III. MEDIUM DIVERSITY. Areas near riverways that average 0.13 miles from the nearest residence. Often subject to machine or construction noises; sometimes to moderate to heavy harvesting or clear-cutting, moderate undercover pruning, and hiking trails.

A minimum of any consecutive arrangement of any of the following:

a. Less common@ sightings of raccoon and deer;
b. Occasional sightings of shorebirds, wading birds, woodchucks, or fox.

IV. LOW DIVERSITY. Suburban-urban wildlife habitat with the nearest residence within 100′ of a riverway.

A minimum of any consecutive arrangement of any of the following:

a. Common sightings of pigeons, starlings, and house sparrows;
b. Occasional raccoons and skunks.

@ Less common - signs of an average of 2 individuals of a species within 400 yards.

@@ Occasional - signs of an average of 2 individuals of a species within 1/2 mile.

II. Method for Relating Development to Wildlife Diversity

Mylar (transparent) enlargements of topographic maps were enlarged to double their normal scale (1"=1000') for each of the three towns, and then the categories of wildlife diversity were mapped on the mylars for all sections of the Kennebunk River system.

Tracing paper was overlaid on the mylars and one inch intervals were measured off for all of the length of the Kennebunk River System. Measurements to the nearest residence were then taken from each interval. These measurements were then listed under the wildlife category shown on the map where the interval occurred, totaled up, and averaged. These are the average distances from the nearest residences for each category:

Low diversity.............less than 100 feet (N* = 13);

Medium diversity..........0.13 miles (N = 79);

Medium-high diversity.....0.25 miles (N = 137);

High diversity............0.43 miles (N = 37).

N* refers to the number of intervals measured.

Medium diversity areas could occur for two reasons. They could be areas of moderate to rich habitat that were too close to human habitation to attract the full range of wildlife, or they could be areas of poorer quality habitat that wouldn't tend to attract much wildlife regardless of their distance from a residence. Several of these latter areas were excluded in the medium diversity measurements. These areas included the ponded wooded wetland around Arundel Swamp Brook, an area of scrub woods near Wards Brook, and the granite and bog country in the northwest corner of Kennebunkport. Their exclusion makes the average distance to the nearest residence much more accurate for the medium diversity category.